CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION • MARCH 1961

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N. Y. International Airport wins ASCE Outstanding Achievement Award–p. 46

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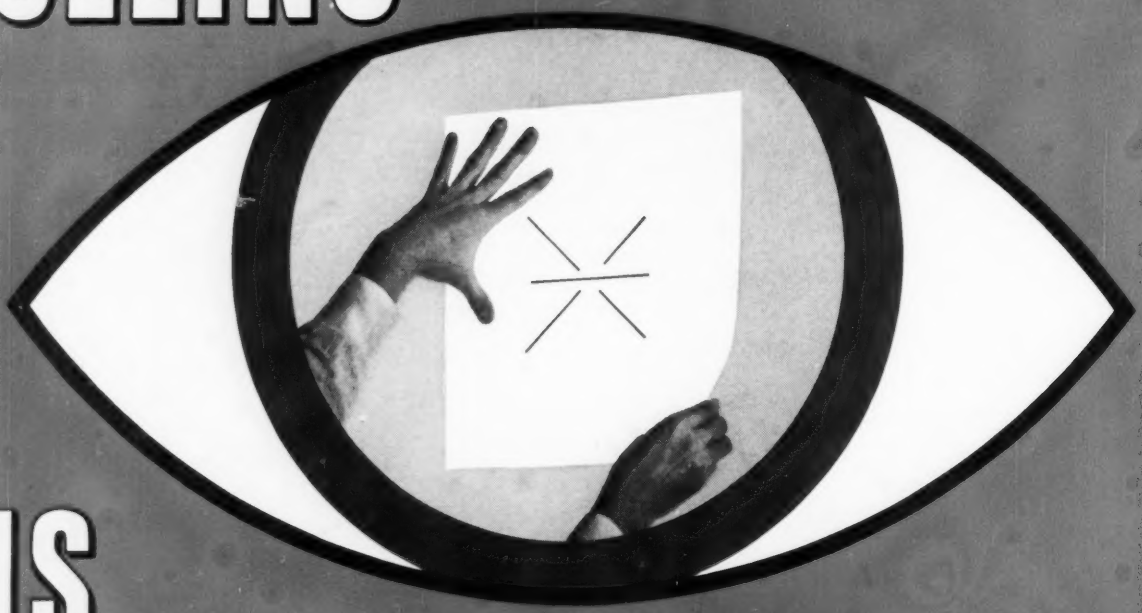

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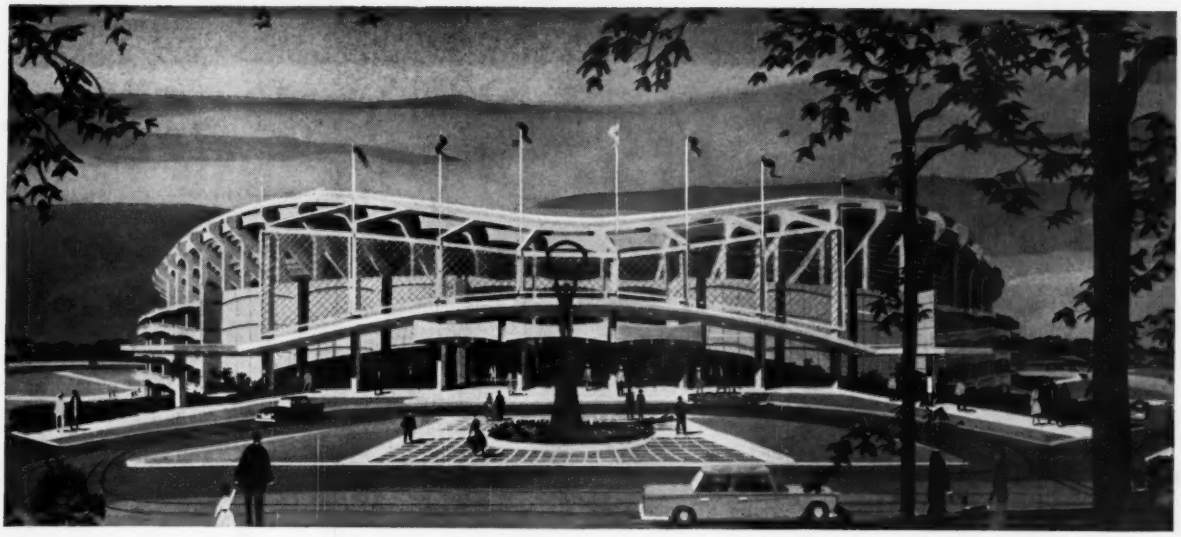

Circular stadium in nation's capital to rest on steel H-piles

A double-decked $19,800,000 stadium to seat approximately 50,000 football fans and 43,500 baseball fans is under construction in Washington, D.C. To support the structure, nearly 6,000 tons of Bethlehem H-piles were driven to 50-ton bearing in a circular pattern.

Steel H-piles, used more than ever for the foundations of major buildings and other structures, are economical because they carry high loads per pile with a liberal factor of safety.

Bethlehem produces a full line of both sheet piling and H-piles. Ask the nearest sales office for free copies of our piling catalogs or write to us at Bethlehem, Pa.

Stadium owner: District of Columbia Armory Board; *Architects and engineers:* Dahl-Ewin-Osborn (George L. Dahl, Dallas, Tex.; Ewin Engineering Associates, Washington, D.C.; The Osborn Company, Cleveland, Ohio; associated for this project); McCloskey & Company, builders.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation

Nearly 6,000 tons of Bethlehem steel H-piles were driven to support the new stadium.

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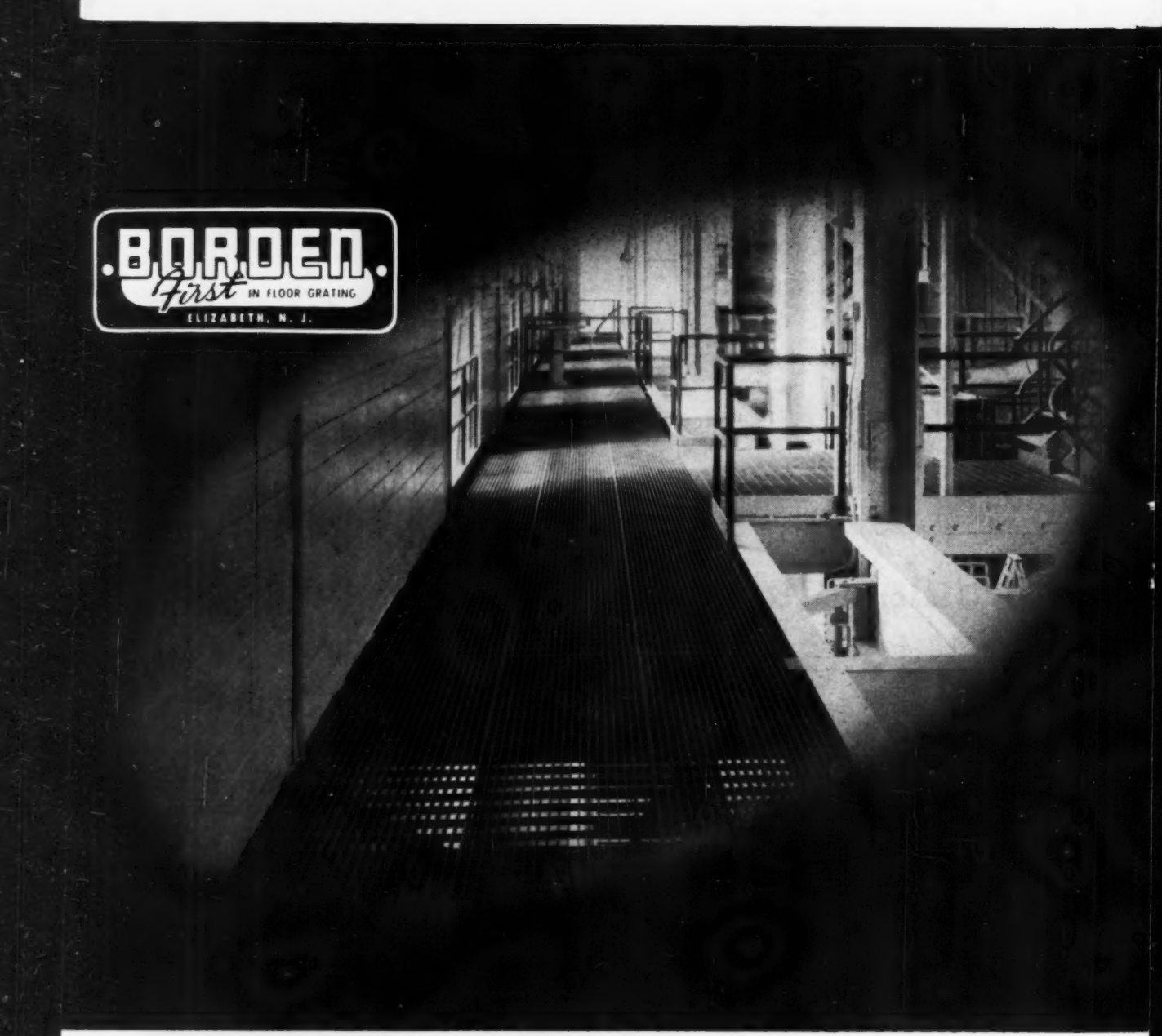

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Simplifies Maintenance, Lowers Total Costs

Now a new installation technique completely eliminates the need to anchor floor grating in place. This allows erection as fast as the structural steel support members are placed and bolted. The technique is only possible with a special reversible Borden Type K panel which will lie perfectly flat on supporting steel with no tendency to rock.

Furthermore, floor grating can now be installed and used for working and walking as quickly as the main structural members are erected. Two men can lift any panel in a matter of seconds for easy accessibility and maintenance.

THIS IS WORTH KNOWING ABOUT!

For complete information, write for technical folder entitled "An Improved Engineering Concept in the Installation of Floor Grating".

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MARCH 1961

VOL. 31 • NO. 3

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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Composite Design for Buildings

Composite design is the technique which permits a concrete slab to work as an integral part of supporting beams. By joining slabs and beams together, through the use of shear connectors, the ultimate capacity of the structure is considerably increased. The structure then becomes monolithic . . . its slabs deforming along with the beams.

FIRST IN BRIDGES. Composite design has been employed in bridge construction since the early '30's for specific economical and structural advantages not found in more common "slab-and-stringer" design. Applying the composite design concept to building construction, we find the same basic advantages still prevail.

REDUCED STEEL TONNAGE. Composite design will usually cut steel tonnage from 15 to 25 percent, thus reducing steel cost. Shallower beams may be used to meet given load and floor deflection requirements—or added load may be accommodated without increasing the beam size.

MORE CLEAR SPACE. The greater load-carrying capacity per pound of steel means wider spacing of columns, more unobstructed floor space.

GREATER DESIGN FLEXIBILITY. When particular floor areas of a building must have higher load capacities, composite design meets these requirements without affecting the rest of the structure.

LESS STRUCTURAL DEPTH. Composite design reduces over-all building cubage. Economies result in the decreased requirement of facing materials, ducts, piping and wiring, as well as columns and foundations.

A CASE IN POINT. The Federal Court House and Office Building of Brooklyn, New York, is the largest Composite Design building to date.* It is a seven-story court house and a four-story office building joined together. Composite design resulted in a 21 percent saving in steel.

DESIGN CONSIDERATIONS. The first method considered was that of conventional design, as shown in Figure 1, using an 18" wide flange, 64-pound beam. It was suitable for the span of 25 feet and was heavy enough to carry both the dead load (concrete) and the live load of 50 pounds-per-square-foot.

The estimate figured steel at 15¢ per pound, erected. Since this beam weighs 1920 pounds, its cost-in-place would have been $288.00.

In considering composite design (see Figure 2), it was found that the beam size could be reduced from an 18" W/F 64 to a 12" W/F 27-pound beam by adding Nelson stud shear connectors and a 17" x 23" bottom cover plate. Also included in the calculations was the need for one shore at center point.

SUBSTANTIAL SAVINGS. On this basis, again figuring at 15¢ per pound for steel, the lighter beam, weighing only 810 pounds, would cost $121.50. About 80 Nelson stud shear connectors would be needed per beam and these were figured at 45¢ each, in place, for a cost of $36.00. The bottom cover plate, shop fabricated, weighed 391 pounds and at 15¢, cost $58.50. The cost of the center shore was figured at $12.00 per beam. This would make the conventional beam cost about $60.00 more than the composite beam, or the difference of $288.00 as against $228.00.

NEW DEVELOPMENT. The recommendations for the design of composite beams in building, as developed by the ASCE and the ACI, are now available. For a copy of these recommendations, plus a new fact-filled booklet on "Composite Construction For Buildings", write to Nelson Stud Welding, Division of GREGORY INDUSTRIES, INC., Dept. 10, 28th Street & Toledo Avenue, Lorain, Ohio.

**Structural Engineers: Seelye Stevenson Value & Knecht, of New York City.*

NELSON

Material and Erection Bid Figures per Steel Beam in Federal Court House and Office Building, Brooklyn, N. Y.

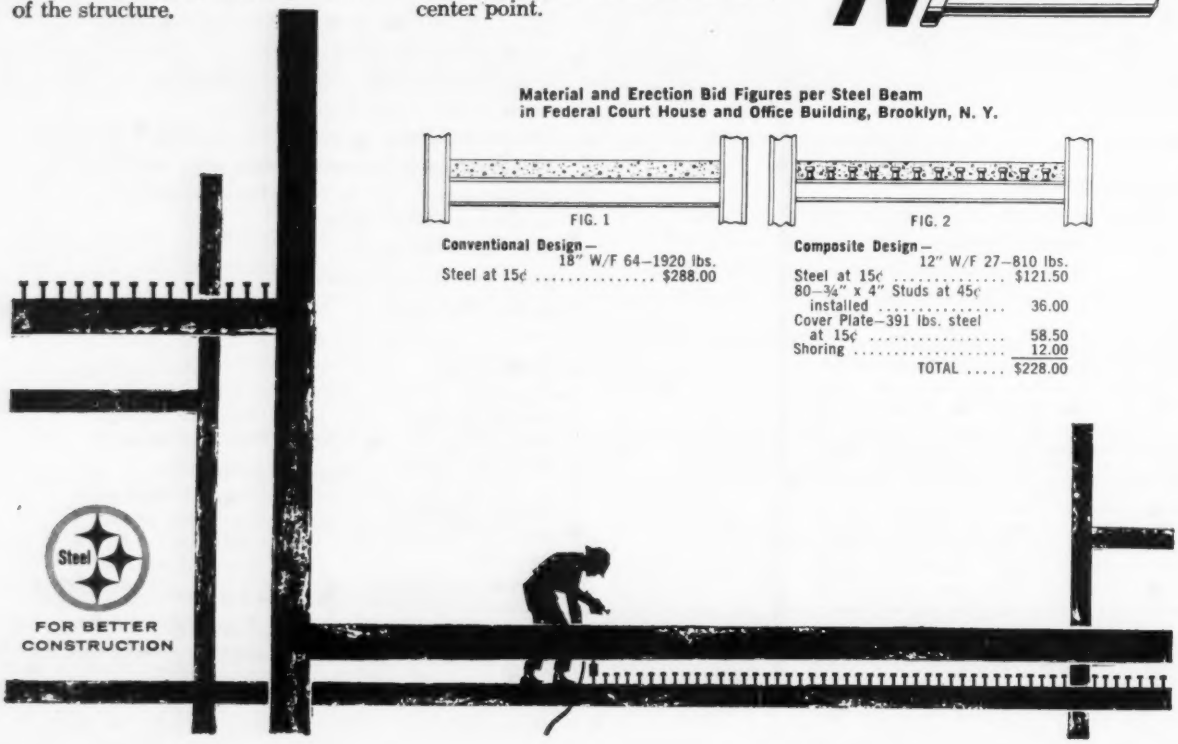
FIG. 1

Conventional Design—
18" W/F 64—1920 lbs.
Steel at 15¢ $288.00

FIG. 2

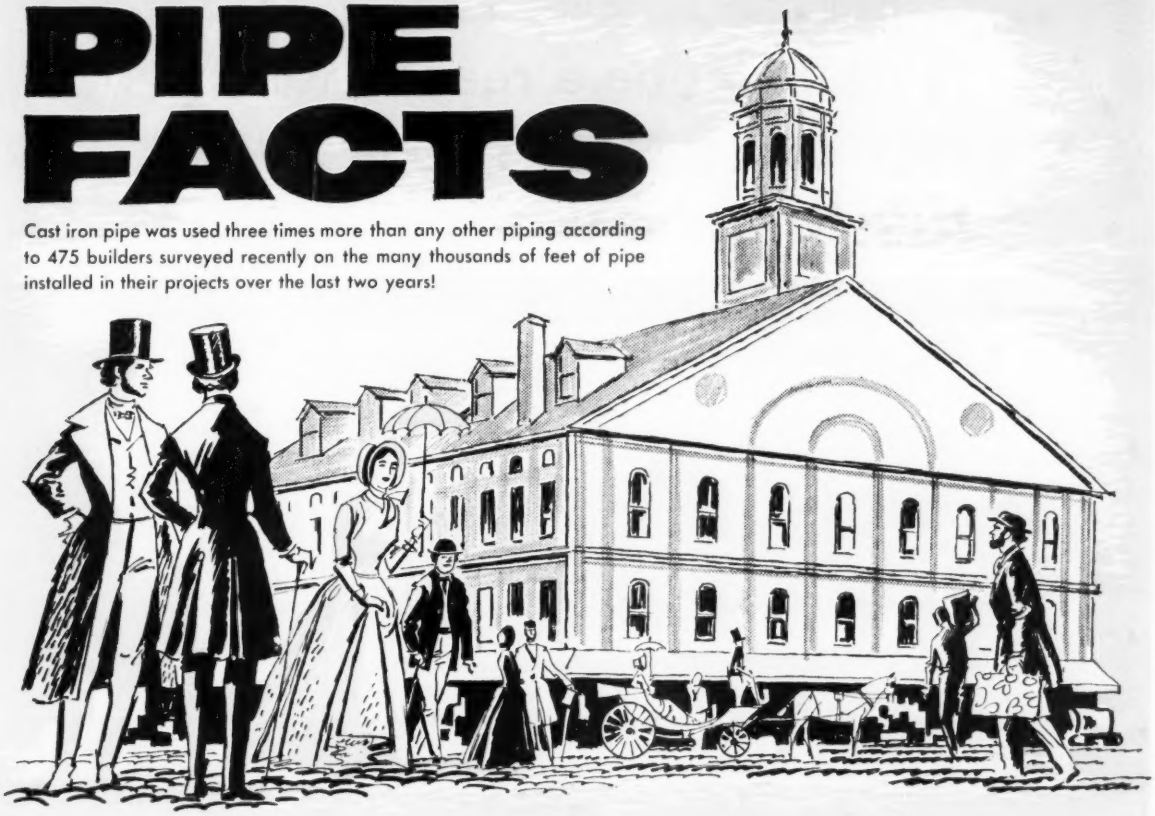
Composite Design—
12" W/F 27—810 lbs.

Steel at 15¢	$121.50
80—¾" x 4" Studs at 45¢ installed	36.00
Cover Plate—391 lbs. steel at 15¢	58.50
Shoring	12.00
TOTAL	$228.00

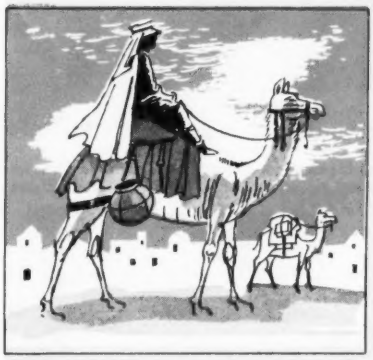


PIPE FACTS

Cast iron pipe was used three times more than any other piping according to 475 builders surveyed recently on the many thousands of feet of pipe installed in their projects over the last two years!

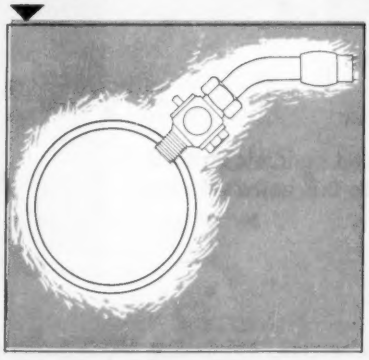


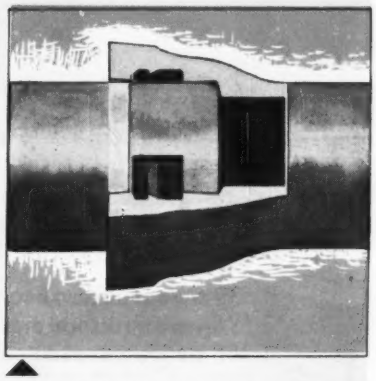
DO YOU KNOW that President Kennedy's great-grandfather landed in Boston in the late 1840's... about the time that Boston's first cast iron water mains were installed? That same cast iron pipe—installed in 1847—is still in service. It is not surprising that more than 100 years later, cast iron pipe continues to be used extensively in Boston's water distribution system.



DO YOU KNOW that camels can go as long as two months without drinking water? For the rest of us, water is a daily necessity... residents of St. Louis, for example, consume 226 million gallons of water on peak days, or 156,944 gallons per minute!

DO YOU KNOW that service taps in cast iron pipe are far stronger than those in composition pipe? Direct force on the corporation cock installed in 6" Class 150 AMERICAN cast iron pipe resulted in breaking the service cock at 1,640 pounds. The corporation cock was torn from the wall of a similar class and size composition pipe at 940 pounds. And the pipe wall failed!





DO YOU KNOW that the AMERICAN Fastite Joint requires only a single joint component ... a superior, double-sealing gasket ... for each 18 or 20-foot length of pipe? Each joint on a 13-foot length of composition pipe requires two gaskets...a double joint with consequent double liability.

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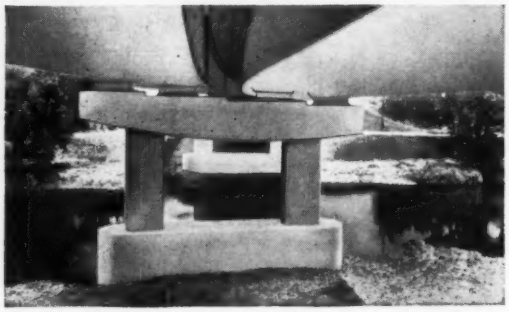
Box Girder Bridge over Kenduskeag Stream
Interstate Route 95, Bangor, Maine
Designers: The Clarkeson Engineering Company, Boston,
Consulting Engineers for Maine State Highway Commission
Contractor: Westcott Construction Company, North Attleboro, Maine

Of 14,703 bridges authorized for federal aid during the years 1957, 1958, and 1959, 2 out of 3 were reinforced concrete construction . . .

9,639 were reinforced concrete
3,696 were structural steel
1,368 were prestressed concrete

There must be a reason for reinforced concrete's preference! On your next project investigate this more versatile, low cost construction material.



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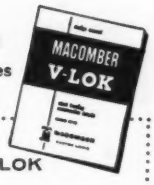

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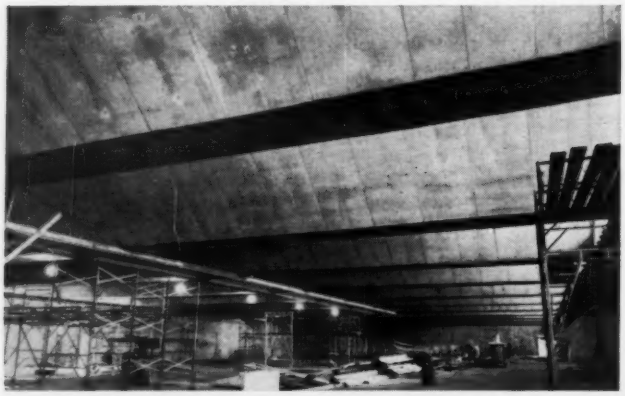
POST-TENSIONED CONCRETE FOLDED PLATE ROOF

Above—The width of each corrugation is 22′. Top and bottom flanges are 8″ thick; inclined webs are 5″ thick. The rods and turnbuckles were used to provide temporary lateral support pending placing of concrete for 8″ open joints between adjacent plates. There are 8 straight post-tensioning cables in the bottom flange of each plate, 3 draped cables in each web. Note, also, the precast concrete window grilles which function as diaphragms.



Above—Concrete folded plates span approximately 125′ and extend the 286′ length of the building. Overall depth is 6′. Plates are supported at one end on columns, at the other by a block wall framed with columns and beams. Even at this stage of completion, it can be seen that the visual effect of these plates will work well with rows of bowling lanes.

Right—Foyer of the bowling center is roofed with 44′ long prestressed double tee beams supported on continuous beams resting on 22′ column centers. The tees were made with Lehigh Early Strength Cement at Wright's Dania plant and trucked to the job site.

Below—Cloverleaf Lanes Bowling Center, now complete at Dade County, Florida.

For 50 Lane Bowling Center

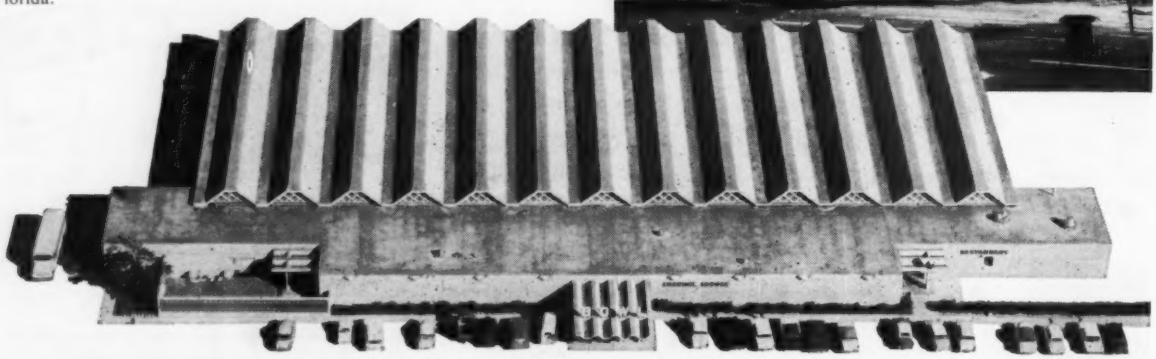
• How to provide 34,000 unobstructed square feet of floor area, in an economical but attractive building, and do it in 7 months from drawing board to grand opening? The answer—use of concrete folded plates, post-tensioned in place, in the recently completed Cloverleaf Lanes Bowling Center, Dade County, Florida.

Lehigh Early Strength Cement Permits Post-Tensioning After 3 Days

Contractor for the plates, John B. Orr, Inc., achieved top efficiency with two sets of forms (for two corrugations each) and Lehigh Early Strength Cement. The concrete, supplied by R. H. Wright, Inc., reached specified post-tensioning strength in three days, meshing neatly with the four day cycle required to strip, move and reassemble a set of forms. There were no delays.

For modern concrete construction, either precast or cast-in-place, chances are Lehigh Early Strength Cement can save you time and money. Lehigh Portland Cement Company, Allentown, Pa.

LEHIGH CEMENTS



Architect: Alfred Browning Parker, F.A.I.A. *Engineer:* Dignum Associates *Contractor:* John B. Orr, Inc. All of Miami, Fla.

Prestressed Double Tees and Folded Plate Post-Tensioning: R. H. Wright, Inc., Ft. Lauderdale, Fla.

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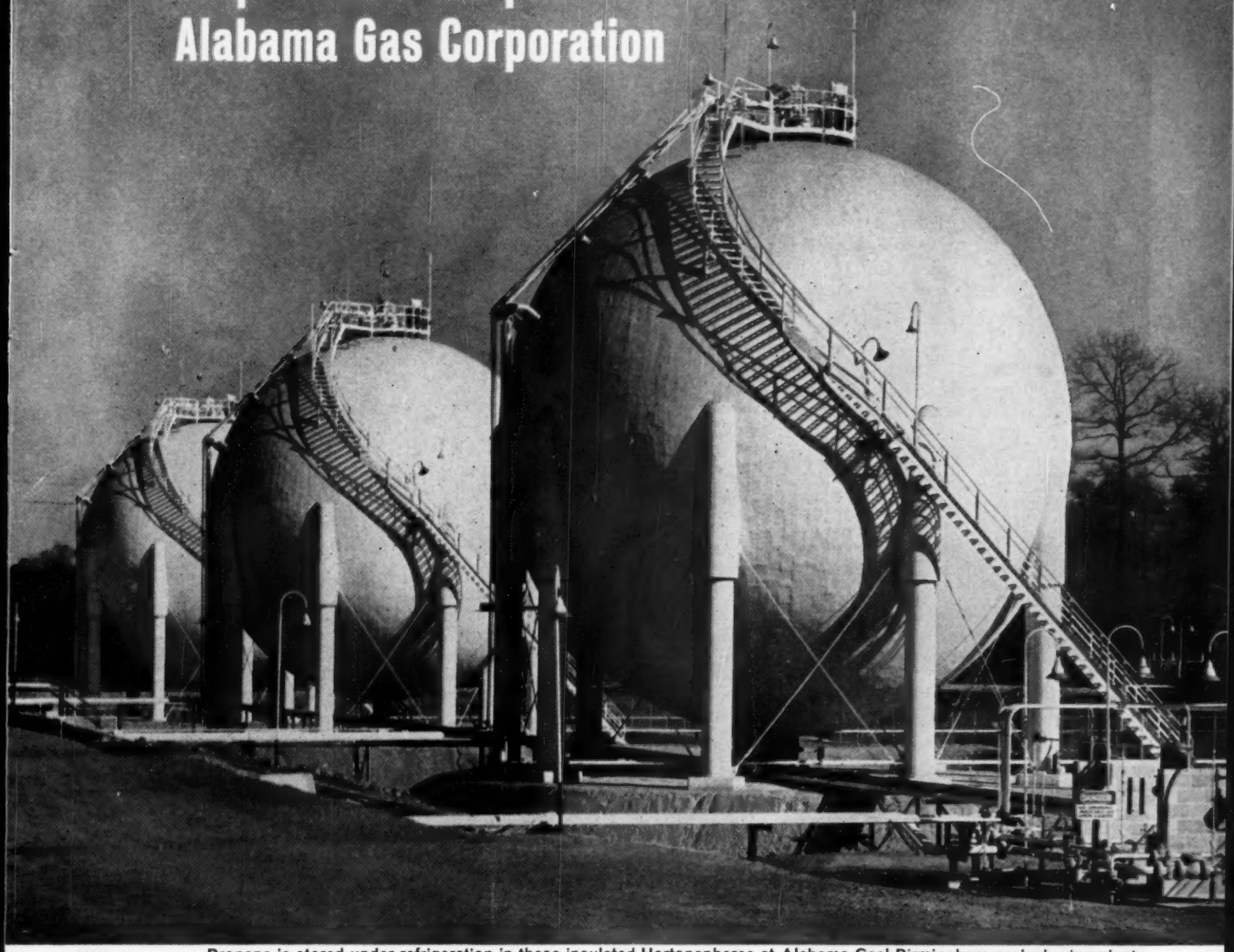
help "shave the peaks" for Alabama Gas Corporation



E60CB Propane is stored under refrigeration in these insulated Hortonspheres at Alabama Gas' Birmingham peak shaving plant.

Alabama Gas Corporation supplies the natural gas that feeds the furnaces of 49 growing communities. When cold weather strikes sunny Alabama, the demand for gas skyrockets. This situation calls for "peak shaving" . . . the boosting of normal gas supplies to meet a temporary condition.

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132″ Lo-Hed® conveyor tunnel being installed for Michigan Limestone Division of United States Steel Corporation at Rogers City.

On completion of Lo-Hed® tunnel at right, 48″ aggregate conveyor system is installed.

91 in. x 91 in. Flat Base utility tunnel for New Jersey firm. Note smooth, watertight joints.

Hi-Hed® makes an ideal utility gallery—assures ample head-room in passage way.

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American-Marietta reinforced precast concrete pipe is available in a variety of shapes. This permits extreme versatility in the design of utility tunnels for carrying steam pipes, gas mains, electrical cables and telephone lines with enough room for workmen to make repairs. In addition to conventional round pipe, A-M offers LO-HED® with greater width under minimum cover; FLAT-BASE with "built-in" walk way; and HI-HED® for minimum vertical load and maximum lateral support under high fills. Find out how much installation time and money A-M Engineers can save on *your* job with *precast* pipe. Write today for information and literature.

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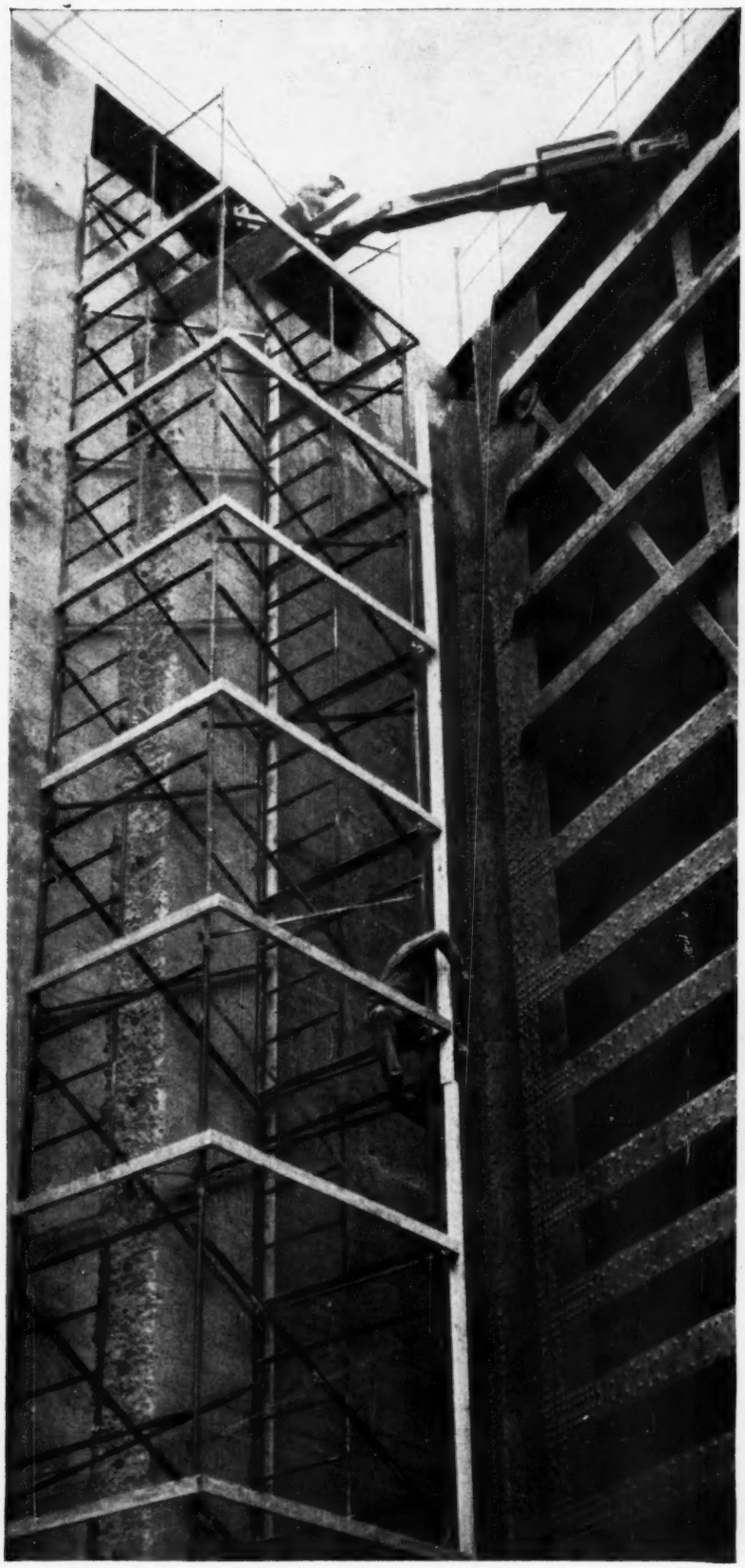
HOW TO MAKE LITTLE OF BIG REPAIRS



Polysulfide-epoxy adhesive speeds, simplifies concrete reconstruction on big river lock

After years of wear and weather, Lock #1 desperately needed reinforcing. Repair time was important. Shipping could not be interrupted for an extended period. Soil conditions were poor. Driving sheet piling proved impractical.

Through use of concrete adhesive combining THIOKOL polysulfide polymer and epoxy resin, engineers met the problems squarely.

By applying the compound to existing base structures (areas where concrete had worn and eroded), they were able to add new sections of reinforced concrete. Adhesive bond between old and fresh concrete provided by the polysulfide-base material proved *stronger than concrete itself*, in effect created one continuous structural unit.

Repairing sidewalls: polysulfide-epoxy adhesive used to grout steel dowels into existing walls, cured inside 24 hours. Well-anchored dowels tie old and newly-poured-in-place vertical columns of concrete. A strong, unified structure delivered well within limited time schedule.

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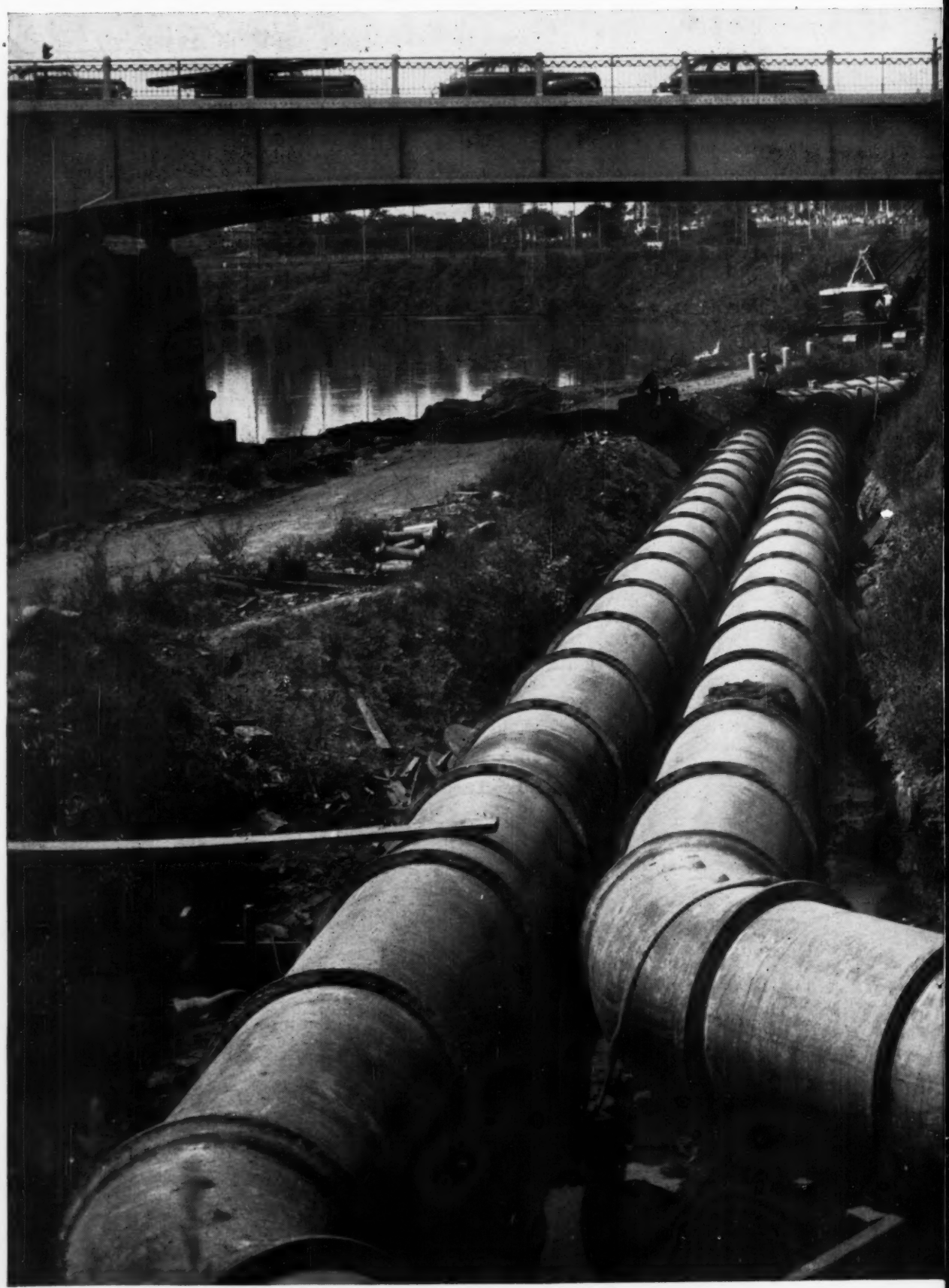

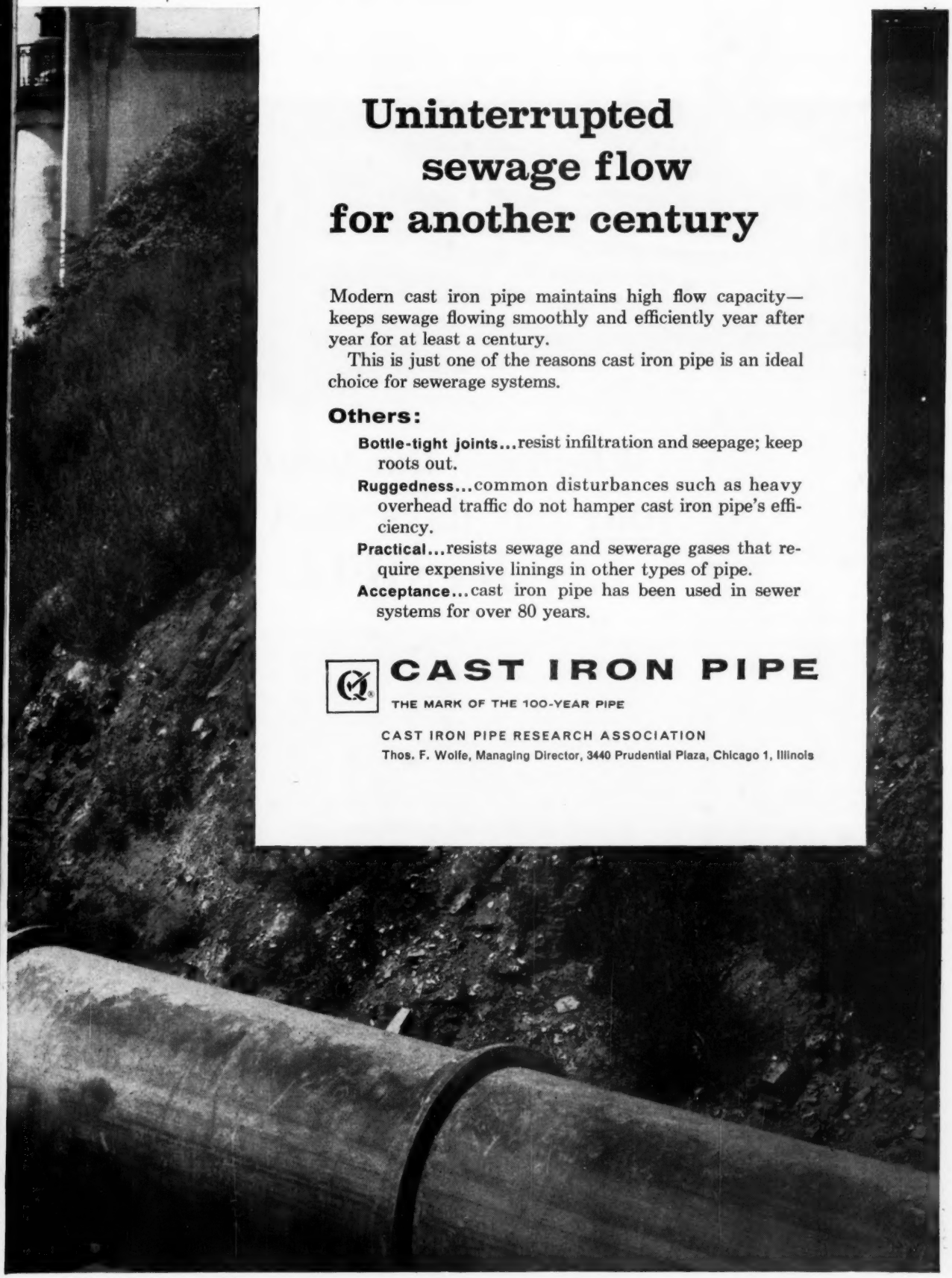

Uninterrupted sewage flow for another century

Modern cast iron pipe maintains high flow capacity—keeps sewage flowing smoothly and efficiently year after year for at least a century.

This is just one of the reasons cast iron pipe is an ideal choice for sewerage systems.

Others:

Bottle-tight joints...resist infiltration and seepage; keep roots out.

Ruggedness...common disturbances such as heavy overhead traffic do not hamper cast iron pipe's efficiency.

Practical...resists sewage and sewerage gases that require expensive linings in other types of pipe.

Acceptance...cast iron pipe has been used in sewer systems for over 80 years.

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

CAST IRON PIPE RESEARCH ASSOCIATION

Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois

Whatever the weather... your pay days start sooner ...with STEEL

STEEL pays off sooner in any weather.

Construction of the steel-framed Harvest House Motor Hotel in Boulder, Colorado, continued on schedule through winter weather. It was completed *three months earlier* than would have been possible with other materials.

Here's what the owner says the time saving meant to him:

Additional Revenue for the Owner

First month — August	**$25,457**
Second month — September	**16,955**
Third month — October	**13,439**
Total for three months	**$55,851**

Plus: Coffee Shop, Dining Room and Cocktail Bar income for three additional months.

It pays to build in steel – not only for earlier income, but for construction on schedule the year around. And steel lends itself so well to modern design that more motorists stop, stay and pay.

American Institute of Steel Construction
101 Park Avenue, New York 17, N. Y.

Steel **STANDS** *for the future*

AISC

HERE'S HOW TO MOVE 18 MILLION GALLONS OF WATER EVERY DAY

In virtually constant use, Peerless pumps insure dependable water flow to utility's 18,000 customers . . .

The Dominguez Water Corporation has a colorful history that dates back to the early Spanish land grants in California. It was first formed in 1911 and its initial patrons were farmers of land which formed a part of the historically famous Rancho San Pedro.

Today this privately owned public utility serves over 17,000 residences and 1,000 agricultural and industrial customers. Its service area comprises a 35 square mile section in the southern part of Los Angeles County.

Throughout the system, this immaculate-looking facility makes virtually constant use of Peerless pumps. Practically all of the water they distribute is pumped by Peerless. From tiny 2 hp Fluidyne pumps and large Type A booster units to mammoth deep well turbines, these sturdy pumps keep water moving in a steady flow. Many of the pumps have seen 25 years or more of continuous service. And downtime for repairs is practically nonexistent, reports operation personnel.

Years of performance. Lowest possible maintenance attention. Best service. These are typical qualities you can expect and get in a Peerless pump. Get the facts on this fine complete line of pumps now. Write today for a catalog and the name of the Peerless representative in your area.

PEERLESS PUMP

Putting Ideas to Work

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PEERLESS PUMP

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Plants: Los Angeles 31 California, and Indianapolis 8, Indiana.

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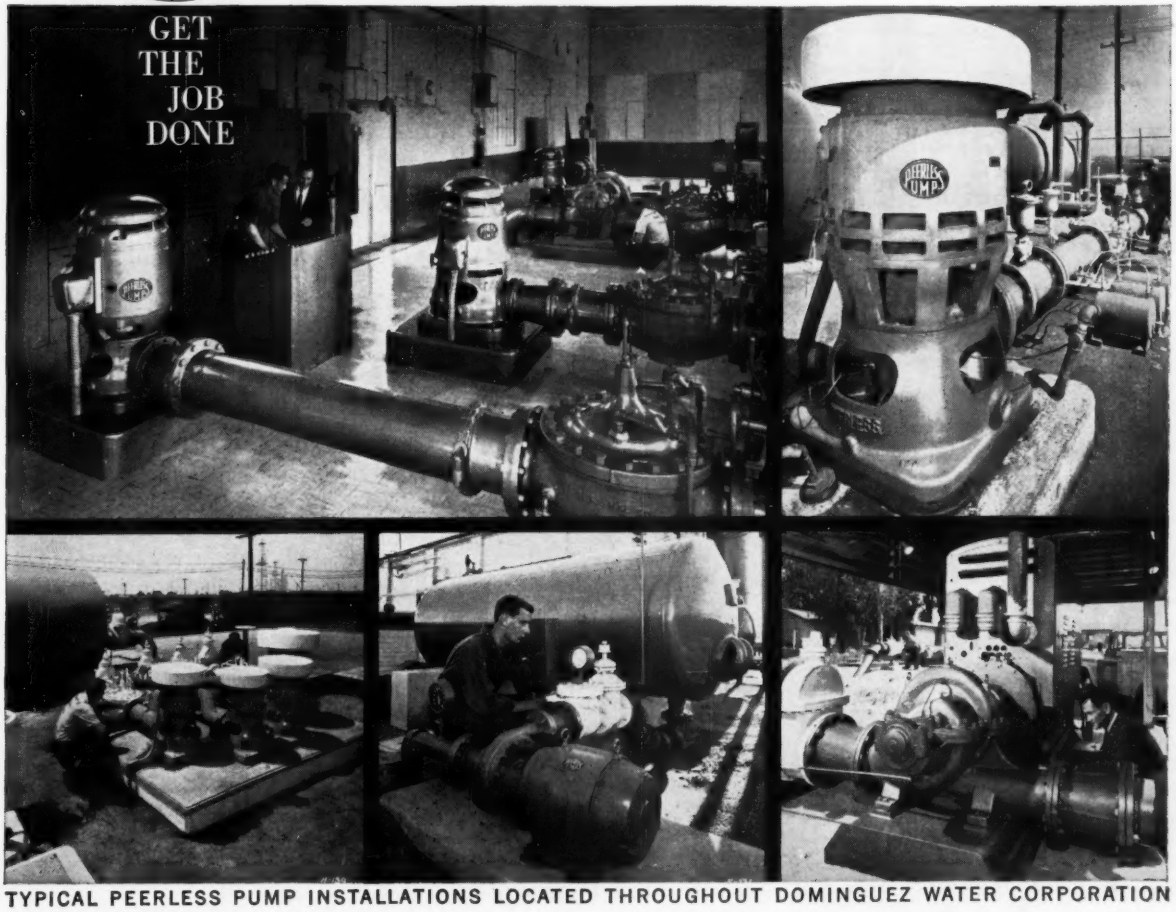

TYPICAL PEERLESS PUMP INSTALLATIONS LOCATED THROUGHOUT DOMINGUEZ WATER CORPORATION

CONCRETE PERFORMANCE REPORT:

Monolithically-cast POZZOLITH concrete lift slabs speed construction of new "twin" apartment buildings

LIFT SLAB

Huron Towers, new twin apartment buildings in Ann Arbor, Michigan, represents the largest scale use of the Youtz-Slick lift-slab method to date.

Two-at-a-time—Concrete floor slabs were placed the full width and length of the building at ground level, then raised into place—two-at-a-time—by hydraulic jacks mounted atop the building columns. The slabs measure 215 ft. x 69 ft. x 9 in. and weigh 830 tons each. Thirty-six jacks were required to lift the gigantic 1,660-ton loads.

No "pour strips"—Ordinarily, with lift slab, each slab is cast in sections which are lifted separately. Pour strips are then formed and placed conventionally. On the Huron Towers project, each floor was cast *monolithically . . . without joints or pour strips* of any kind.

Strength, plus economy—Specifications originally called for a minimum of 6.5 bags of cement for 4000 psi concrete. Preliminary tests, however, showed that the *specified strength could be obtained most economically* by using 5 bags of cement and POZZOLITH . . . and provided the desired reduction in shrinkage that allowed construction of these large slabs without pour strips. This mix design was submitted, approved and used throughout the Huron Towers project. All tests on POZZOLITH ready-mix concrete exceeded the specified strength.

Master Builders MBVR air-entraining agent was also employed in all slab concrete to obtain the air content specified for the outer portion of each slab, which will ultimately be a cantilevered balcony exposed to weathering.

Aside from the record number of liftable slabs and the near-record lifting height, the Huron Towers project includes two other interesting features: The concrete casting operation and the method of winter protection.

Contractor ingenuity—Since most of the floors in the two buildings are identical, the contractor developed a unique sequence of casting the slabs at the lower-basement floor level. One complete floor, covering nearly 15,000 sq. ft. and containing 410 cu. yd. of concrete, was cast in a three-day cycle. As soon as one crew had completed placement of the 33 tons of reinforcement and conduit for the floor slab in one building, it moved to the other building to begin preparing a new slab. At the same time, another crew placed concrete for the slab in the first building, pumping it into place through an 8-inch line, at a rate of 40 to 60 cu. yd. per hour, from a centrally-located pump.

Weather, or not—This sequence of slab-casting operations was maintained throughout the winter months by protecting the working areas from freezing by enclosing them with 75,000 sq. ft. of lightweight plastic material and maintaining a temperature of approximately 55 F. One-percent calcium chloride was added to the mix to accelerate early strength gain.

POZZOLITH concrete was used throughout both buildings for (1) *ease of pumping* . . . there were no plugged lines during the entire pumping operation (2) *virtually no honeycomb* . . . despite intricate reinforcing steel and electrical and mechanical work in the slabs (3) *minimized shrinkage and cracking* . . . inspection after lifting showed no cracks through the slab.

Approximately 12,000 of the 25,000 cu. yd. of POZZOLITH ready-mix con-

LOWER BASEMENT FLOORS in both buildings were cast on the ground to serve as casting beds for the liftable slabs. The ground floor and upper basement floor slabs are 14″ plus 2½″ joist-type slabs spanning onto wide flat beams of the same depth. The 12 apartment floors and the roofs are flat slabs, all 9″ thick except the first living floor, which is 10″.

HURON TOWERS, Ann Arbor, Michigan, was designed by King and Lewis Architects, Inc. with structural engineering by R. H. McClurg Associates, Inc.—both of Detroit. Project Manager was B. R. Sloan and Project Engineer, Willard C. Reeder—both of Long Construction Company, General Contractor, Kansas City, Mo. F.H.A. Resident Engineer was Hugh Foley. Lift slab Consulting Engineer was Robert D. Campbell, Kansas City, Mo. Killins Gravel Co. of Ann Arbor supplied the POZZOLITH ready-mix concrete.

TOWERS

MAXIMUM LIFTING HEIGHT of roof slab for this building was 145 ft. For its "twin"—142 ft. The number of liftable slabs—15, in this building, sets a record as the greatest number of concrete decks to be lifted in the United States. Total floor area of the two apartment buildings is 465,000 sq. ft.—431,000 of which were lifted.

crete were used in the lift slabs—the balance went into the foundation and attached parking garage.

Field service—Master Builders field man worked closely with the engineer, contractor and ready-mixed concrete producer on the Huron Towers job to aid in achieving the common goal of uniform, high-quality concrete at lowest cost-in-place.

No matter how large, how small, how unique or how conventional the project, call in the local Master Builders field man. He will show you how concrete produced with POZZOLITH is a more durable and versatile building material . . . superior in performance, quality and economy to plain concrete or concrete produced with any other product.

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Division of American-Marietta Co.
Cleveland 18, Ohio
World-wide manufacturing and service facilities

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MASTER BUILDERS. POZZOLITH*

POZZOLITH *is a registered trademark of The Master Builders Co. for its ingredient for concrete which provides maximum water reduction, controls rate of hardening and increases durability.*

MORETRENCH EQUIPMENT PREDRAINS WORLD'S LARGEST DRY DOCK

When the U. S. Navy undertook to build the world's largest dry dock, a formidable foundation problem faced the engineers. The site was partially on "made" land requiring 600,000 cubic yards of dredging and 1,300,000 cubic yards of fill.

A fully-relieved type of dock was designed, in the construction of which an elaborate Moretrench drainage system to relieve the groundwater pressures was a key element.

The cross-sectional sketch at the right shows the general pumping plan. A system of Moretrench submersible-type deep well pumps augmented with a perimeter stage of Moretrench Wellpoints gave the contractor a dry, unobstructed working area about 1200 feet long and 220 feet wide, 65.2 feet below mean high water.

Additional wellpoints are being used to dewater the pump well area to a total depth of 84.3 feet below mean high water.

Photo on the left shows the cofferdam being constructed; photo on the right shows the excavation being bottomed out after predrainage, with drainage course material being placed in the foreground.

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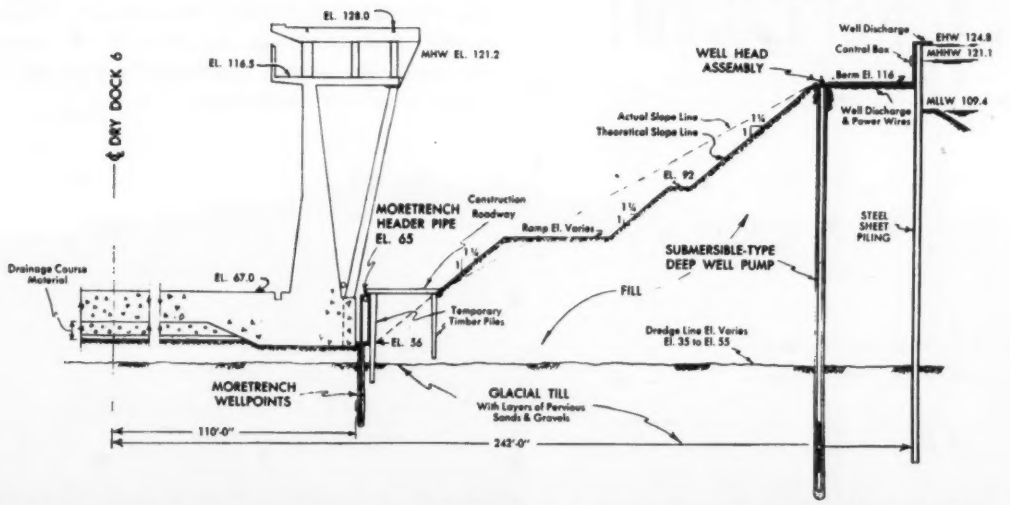
Dry Dock No. 6
Carrier Repair Site
Puget Sound Naval Shipyard
Bremerton, Washington

Architect-Engineers: Moran, Proctor, Mueser & Rutledge, New York — Carey & Kramer, Seattle, Washington

Contractor: Manson-Jones-Perini-Osberg
Bremerton, Washington

Pumping Contractor:
American Dewatering Corporation,
Rockaway, N. J.



This project was under the supervision of the District Public Works Office, Thirteenth Naval District, Seattle.

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BRITISH REPRESENTATIVE
Blaw Knox Limited London

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315 W. 25th Street
Houston 8, Texas
Tel. Underwood 4-7774

"Rock is nothing new for this TD-25"

Contractor Preston Cottrell, Kalispell, Montana, owns this International TD-25 that's roughing out a mountain logging truck haul road on swampy, rocky, machine-mauling terrain. The TD-25's operator, William Clark, comments: "This '25' worked in rock all summer—works well in rock; has got lots of 'soup.' And it's got the special advantage of having the power on both tracks all the time." Owner Cottrell adds: "Best of all tractors I've ever used for road-building."

How Owners rate Planet-powered "25's" COMPARED TO

"TD-25 outworks any rig of its size we've used"

Dry Dock No. 6
Carrier Repair Site
Puget Sound Naval Shipyard
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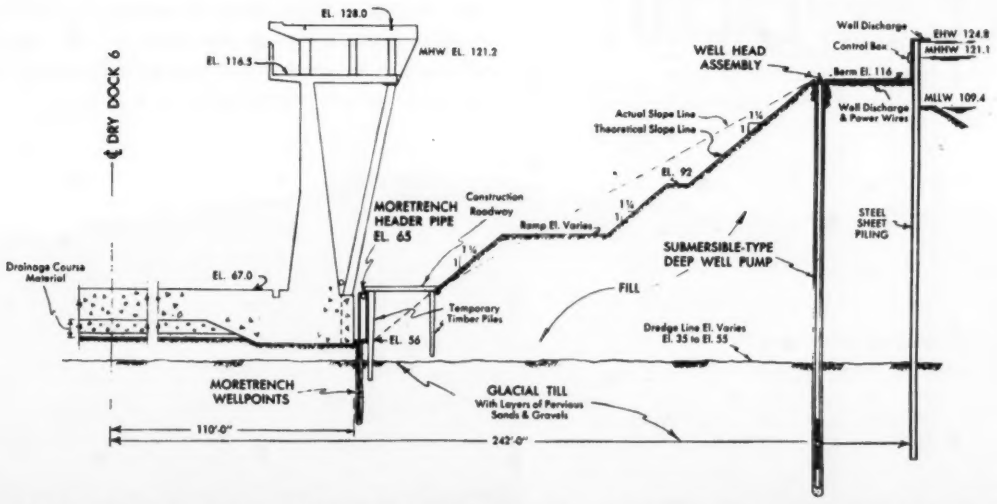

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"Better pusher control on all terrain"

"TD-25 planetary steering gives the operator better pusher control of the scraper load in all types of terrain conditions," states Grady B. Stancil, Stancil Bros. Construction Co., Snellville, Ga. "TD-25 has no match for work on grades as it will back up slopes and maneuver." View shows Stancil TD-25 pushing an International Payscraper on state highway job near Lawrenceville, Ga.

"Our TD-25's save time and dynamite in rock"

"The road-building capacity of our TD-25's is something you must see to believe," declares Contractor Russell Train, Myrtle Point, Oregon. "They cut the roads out faster—save time and the cost of dynamite ripping through rock strata we always had to blast before." Here's one of owner Train's TD-25's benching out type EE Forest Service roads that will be rock-coated for all-weather use.

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How Owners rate Planet-powered "25's" COMPARED TO THE CRAWLERS THEY REPLACED!

"TD-25 outworks any rig of its size we've used"

"Our TD-25 does more work in a day than any competitive tractor its size we've ever used," reports Gen. Supt. G. H. Crouch, for W. Owen Flowe & Son's contracting firm, Charlotte, No. Carolina. "Live track steering and over-all balance enabled the TD-25 operator to grade within .02% of the 24-degree, 1,000-foot long track slopes—within four hours. A motor grader would have taken two days to do this same job. TD-25 live track Planet Power-steering gives accurate load control with no side slip." Here, TD-25 is digging out a 20-ton boulder—a step in building the huge new Charlotte motor speedway racing track.

"TD-25 Planetary steering benches rock in 2nd gear"

"Planet Power-steering makes the TD-25 especially good for benching and bank-cutting—and it really takes the passes of rock in second gear (where 1st gear is usual with clutch-steered rigs)," states Kinney Hamm, for Albert Brothers Contractors, Roanoke, Va. "I can operate the '25' with my little finger, and with confidence." This Albert Brothers' TD-25 is blading huge loads of shot rock aside on a hilltop cut of an Interstate Project near Buchanan, Va.

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See how "live track" TD-25 Planet Power-steering gives you full-power momentum—and eliminates load-limiting "dead-track drag." Try on-the-go, Hi-Lo power-shifting that ends "gear-shift lag." Compare how this power-steering, power-shifting combination teams with 230 work-slugging turbocharged Diesel hp—to outwork king-sized clutch-steered crawlers job after job! Let your International Construction Equipment Distributor demonstrate the TD-25!

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NEWS OF MEMBERS

Nicholas V. Feodoroff, an international authority in the field of hydraulics and associate professor of civil engineering at Manhattan College, New York, recently became a fellow of the oldest scientific society in the world, the Royal Society for the Encouragement of Arts, Manufactures and Commerce of London, England, founded in 1660. He is already an officer in the French Academy of Science.

Maurice David Glessner, retired civil engineer of Escondido, Calif., began his engineering career with the Government as a topographic recorder with the U.S. Geological Survey and ended it as a construction engineer for the Corps of Engineers on the Isabella Dam on the Kern River and the Pine Flat Dam on the Kings River. He has served in the Reclamation Service, the Coast and Geodetic Survey, the Alaska Boundary Survey, the Alaska Engineering Commission, and the U.S. Forest Service.

Bryant Hopkins, former Maine State Senator, has retired as river engineer of the Kennebec Water Power Company after 40 years of service. He has established a consulting engineer's office at 8 Water Street, Waterville, Me.

Robert E. Wilde, from 1952 until recently managing editor of the American Concrete Institute's monthly *Journal* has been appointed to the newly created post of assistant secretary, while **Robert G. Wiedyke** has been promoted from associate editor to that of managing editor. Mr. Wiedyke first joined ACI as assistant editor in 1954.

John S. Mead, for the past three years a staff assistant in the civil engineering branch of the U.S. Forest Service, has been transferred from the Washington, D.C., office to the Denver, Colo., regional office, where he will be in charge of the civil engineering branch. In another transfer, **R. M. Peterson** has switched from the Forest Service regional office in Missoula, Mont., after two years in charge of the hydraulics and water improvements branch in the engineering division there, to a staff assistant position in the Washington, D.C., office.

Michael R. Pender has accepted a position as assistant to the executive vice president of the New York World's Fair 1964-1965 Corporation. For the past ten years Mr. Pender has been with the consulting engineering firm of Madigan-Hyland engaged on feasibility studies for such projects as the New York State Thruway, the Tappan Zee Bridge, and Kingston-Rhinecliff Bridge.

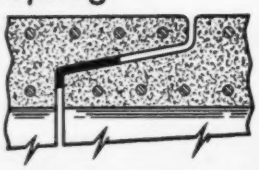
Adrian R. Chamberlain, one of the youngest administrators on the campus of Colorado State University, has been named its vice president for administration. Dr. Chamberlain joined the CSU staff as research coordinator in 1956, after receiving in 1955 the first doctor of philosophy degree ever awarded by the University. During the past three years he has exercised administrative and technical supervision of research projects totaling half a million dollars annually.

(Continued on page 24)

TYLOX "C"
Rubber PIPE GASKETS

. . . provide visual proof of correct pipe coupling

Hamilton Kent Type "C" TYLOX Gaskets for concrete sewer pipe provide watertight joints at head pressures up to 50 feet. Gasket consists of base, multiple sealing fins and *inspection flange* which overhangs the edge of the pipe tongue, or alternately, the tongue offset, according to the type of pipe.



TYLOX "C" Gasket under full compression. Note the visual inspection feature.

"C" Gaskets are of true compression type, made of either rubber or neoprene. They may be installed at the job site, or pre-assembled at the pipe manufacturer's plant. Compounded specially to resist sewerage and industrial waste acids, they never deteriorate. Under ground and under compression, TYLOX "C" Gaskets outlast the pipe itself. Write for brochure.

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Well Casing to meet every Soil Condition

from 6" to 36" diameter and 4 different perforations to meet your special requirements. For a permanent, trouble free well put down Thompson Stainless Steel Casing.

Parshall Measuring Flume

Accurate to .02 regardless of stream velocity, self cleaning, easily read, approved by State Engineers. 6" to 12' throat widths galvanized or black. Ideal for water and sewage control.

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Control water levels, upstream or downstream, assures equitable distribution 24 hours a day . . . entirely self operating . . . no gate keeper necessary. Prevents costly washouts and flood damage. Proven in USA, Europe and Africa. Write for full information . . . there may be an automatic gate near, for your inspection.

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☐ Custom Fabrication ☐ Automatic Water Control Gates

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3017 Larimer Street Denver 1, Colorado

Bethlehem can make fast delivery of new high-strength bolts

Bethlehem stocks the new high-strength bolts for structural steel joints (large head, short thread) in all popular sizes—5/8 to 1 1/8-in. diameters, inclusive, in usual lengths, available now. Available soon—1 1/4-in. diameter, in usual lengths.

- We will continue to maintain complete stocks of 5/8 to 1 1/4-in. diameter high-strength bolts in all lengths with regular heads and A.S.A. Standard thread lengths.
- Hardened washers, made to both the new and old standards, are available in all types and sizes for quick shipment.
- Our new booklet 563A, "High-Strength Bolting for Structural Joints," contains the latest specifications, and complete information. Get your copy from the local Bethlehem office, or write to us at Bethlehem, Pa.

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Milton F. Wagnitz, for the past six years city engineer of Detroit, is retiring in March after 42 years with the Detroit Department of Public Works. Three times, Mr. Wagnitz' retirement was deferred "in recognition of his qualifications and because of significant engineering projects which were still under construction." Scheduled to take over as city engineer is **Clyde L. Palmer,** who has been with the Department since 1926.

Sidney F. Borg, professor and head of civil engineering at the Stevens Institute of Technology, has been appointed editor of a new *Civil Engineering and Applied Mechanics Series* of textbooks to be published by the D. Van Nostrand Company, Inc., of Princeton, N.J. Among the books to be included in the series are several by Dr. Borg.

Frank A. Butrico, a career officer in the Public Health Service Commissioned Corps, has been appointed to the new post of assistant chief engineer for the Public Health Service. Mr. Butrico has represented the Service at both national and international gatherings; and is the author of numerous papers and publications in the sanitary engineering field.

Roy A. Nyquist received the honorary degree of Doctor of Engineering at the recent dedication convocation for the new Engineering-Science Building at the University of Toledo. Earlier in the day, he represented industry on a panel discussion of "Education for the Engineer and the Scientist—Challenging Requirements of the Decade." Currently he is director of engineering for the Libbey-Owens-Ford Glass Company at Toledo, having joined the organization in 1934 as assistant chief engineer. He was promoted to chief engineer in 1951 and director of engineering in 1955.

Mihills O. C. Kelson, who during 24 years with the Corps of Engineers has assisted in the planning and design of Bonneville, McNary, Chief Joseph and The Dalles dams on the Columbia River, is the new chief of the Corps' Construction Branch of the North Pacific Division. He has served the North Pacific Division since 1949.

Warren J. Scott, after many years' service to the State of Connecticut—most recently as director of the Sanitary Engineering Division of the State Department of Health, retired on February 15. As a tribute to Mr. Scott's career, his friends and associates held a testimonial dinner in his honor on February 16.

Lester L. Lessig, since 1949 contracting manager in the Bethlehem Steel Company's Philadelphia district sales office, retired on January 31 after more than 43 years with the company.

Harvey Edward Wahls has joined the civil engineering faculty at North Carolina State College as assistant professor. Prior to his new appointment, Dr. Wahls was a research associate at Northwestern University.

Samuel B. Nelson, after 34 years of service with the Los Angeles Municipal Department of Water and Power, has been appointed general manager of the department. For the past five years he has been chief engineer of the city's water system.

Edward S. Taub and **Maurice R. Scharff,** New York City consulting engineers, will continue their respective independent professional practices in joint offices at 300 East 46th Street. Plans call for them to share their facilities with other consulting engineers in other fields.

Paul A. Wilson is retiring on March 1 as area manager of the Atomic Energy Commission's Los Alamos area office after almost 36 years of Government service. His last position, before joining the AEC in 1949 as chief of the Laboratory Engineering Branch of the Los Alamos Scientific Laboratory, was with the Corps of Engineers, as chief of the Engineering Division of the Albuquerque District.

Harry L. Fox, recent recipient of a second Oak Leaf Cluster to the Army Commendation Medal for Meritorious Service, has retired from the Army after 20 years of service, to join the Associated General Contractors in Atlanta, Ga. For the past several years, Colonel Fox has been deputy division engineer of the South Atlantic Division.

A. P. Rollins, Jr., Colonel, Corps of Engineers, U.S. Army, has a new assignment as district engineer for the Corps in Kansas City. Colonel Rollins recently returned from duty in the Pacific area.

Robert Zaborowski, formerly president of Thompson-Starrett Company, Inc., and Roberts & Schaefer Company, of Chicago, is now a partner in Dahlquist & Zaborowski, Inc., architects and engineers, of Glenview, Ill.

Jimmy W. Seyler, assistant professor of civil engineering at the University of Illinois, assumed part-time duties in the University's Division of University Extension on February 1. Professor Seyler will be on joint appointment in the Division of University Extension and the College of Engineering with title of assistant professor of civil engineering and extramural classes. He has been on the faculty there much of the time since 1947.

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"INSTANT 2-WAY RADIO CONTACT"

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New 2-way radio actually fits into your pocket. Exclusive, rechargeable battery lasts year or more. Range—½ to 1 mile. No license required.

GLOBE ELECTRONICS
Pocketphone
THE FINEST 2-WAY RADIO AVAILABLE TODAY

Ideal for office, factory, stores, surveying, construction, sports, recreation, home. Finest quality available. Makes handy paging system. Use with Globe Electronics CB-100A or CB-200 for longer range systems.
• Actual size — 1⅝" x 2¾" x 6¼" • Weight – 13 oz. • High impact Cycolac case • All Transistorized. $125.00 each

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CITIZENS BROADCASTER CB-100A . . . Complete 3-channel, 2-way station. Fixed or mobile installation. Easy to install, operate. Range 5-15 miles. $139.95 each

BROADCASTER DELUXE CB-200 . . A rugged transceiver for commercial use. Transmits on 5 channels. Receives on all 22. Adapts to selective calling system. $189.95 each

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ADDRESS _____
CITY _____ STATE _____

W. G. Kirkland, who has been elected an assistant vice president of the American Iron and Steel Institute, New York City, will be concerned primarily with building research and technology. His last position was as chief of the Institute's engineering division.

Richard T. Dewling, a 1958 sanitary engineering graduate of Manhattan College, New York, is now assistant editor of *Wastes Engineering* and *Water Works Engineering,* publications of the Reuben H. Donnelley Corporation. Mr. Dewling, awarded a full scholarship to the New York University Graduate School of Engineering by the New York City Department of Public Works, where he has been employed for the past two and a half years as a sanitary engineer, will receive his master degree in civil engineering this year.

Vincent J. Urbano, formerly field engineer and estimator for Joseph R. Farrell, Inc., contractors of Conshohocken, Pa., is now project engineer with the Philadelphia firm of industrial engineers, George K. Heebner, Inc. He has also been employed as an engineer with Micklewright and Mountford, Inc., of Trenton, N. J.

W. R. Engstrom, vice president since 1943 of the Austin Company which he joined 36 years ago and now its Seattle district manager, has been elected a director of the international engineering and construction firm. Named assistant general sales manager with headquarters at the company's General Offices in Cleveland is another 30-year man, **William Vanderhout,** who through the years has been closely identified with the firm's major projects in New England. The appointment of **Edward C. Baker** as district engineer of the Chicago District continues the list of recent changes at Austin. Mr. Baker, a staff-member for the past 15 years, succeeds **George H. Miller,** transferred to headquarters of the Northwest district in Seattle as a project manager on special assignment. **Loren C. Miller,** works manager of Austin's Steel Fabricating Division in Cleveland and with the firm since 1949, has been appointed assistant manager of the Chicago District. He will be succeeded as works manager by **Louis O. Schaefer,** for the past two years in the Steel Fabricating Division.

Francis B. Slichter is retiring in March after 32 years of service with the Corps of Engineers. As chief of the engineering division, civil works, in the Office of the Chief of Engineers for the past twelve years, he was responsible for the design and served as consultant on construction of large dam and hydroelectric projects and other river, harbor and flood control improvements built by the Corps.

(Continued on page 26)

TESTS PROVE:

NEW JOINTING MATERIAL LASTS LONGER THAN SUBSTITUTE PIPE

Lifetime Vitrified Clay Pipe—which is chemically inert and can't be damaged by gases and acids normally found in sewer lines—has been the standard of excellence for centuries.

But how about the new resilient jointing materials now being used on Clay Pipe? How do they stand up under acid attack?

Samples of standard jointing material have been suspended in sewer lines in cities all over the country to see how they react to normal exposure. But we wanted to find out quickly if they stand up to sulphuric acid—the number one killer of sanitary sewer lines built of substitute pipe.

In one test, samples of cement-asbestos, concrete and clay pipe and five jointing materials were weighed dry, then exposed to a five-percent sulphuric acid solution for 100 days. They were then removed from the acid, dried, and weighed again to observe weight loss and disintegration.

The results were amazing!

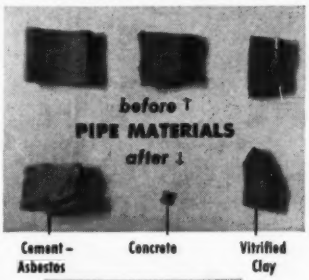
The sample of concrete pipe was completely disintegrated. The sample of cement-asbestos pipe was badly laminated and almost disintegrated.

But there was no evidence of any deterioration of either the jointing materials or, naturally, the Vitrified Clay Pipe.

Get all the facts* before you specify any kind of pipe for your community's sewer line. There's no substitute for lifetime Vitrified Clay Pipe with the new compression joints.

**Further explanation of this experiment is available on request.*

Pipe and jointing materials after 100 days exposure in 5% Sulphuric Acid Solution



6 NEW JOINTING MATERIALS

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9 Twin Bridges

Symons Steel-Ply Forms Lick Tight Schedule

. . . Forms Set Horizontally and Stripped in Sections

Eight months to build the piers and substructure for nine twin highway bridges. Moore Brothers Construction Co., Verona, Virginia had this tight schedule to meet . . . and made it. Figuring concrete formwork correctly was an important factor in meeting the schedule.

The bridges are part of the 28-mile superhighway that connects the new Dulles International Airport at Chantilly, Va., with Washington, D.C.

On this project, the forms were assembled, stripped and moved easily by

Symons Forms are easily moved from completed pier (right) to new pier at left. Symons scaffold brackets aided materially in setting up forms.

manpower so that the forms could be reassembled on a second pier while the first was being stripped. Concrete was poured at the rate of about 3 feet an hour with each pier poured in a continuous operation.

The complete *Chantilly story* sent *free* on request. Symons Steel-Ply Forms are rented with purchase option.

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MORE **SAVINGS** FROM **SYMONS**

Theodore E. Mann, with the Bureau of Reclamation since 1934, has left Helena, Mont., where work is ending on the Helena Valley Unit, to start construction on a new $22 million project at Dillon, Mont., as project construction engineer. Mr. Mann is currently president of the Montana Section.

Edwin L. Jones, Jr., will direct the world-wide activities of the J. A. Jones Construction Company in his new capacity as president. Mr. Jones joined the company in 1946 and was promoted from the position of vice president and administrative assistant to the presidency. **Emil J. Kratt,** who in his 26 years with the firm has managed many of its major undertakings, has been promoted from the position of first vice president to the newly created position of vice chairman of the board of directors.

Seymour A. Potter, Jr., Colonel, Corps of Engineers, and New England Division Engineer, has been promoted to Brigadier General. An officer of the Corps since 1941, General Potter has been in his present assignment since October 1960.

George E. Barnes is on leave of absence until September from the Case Institute of Technology, where he is professor of hydraulic and sanitary engineering, to serve as visiting professor of sanitary engineering at the Central University of Venezuela. A member of the Case faculty since 1933, Professor Barnes has served as a consultant on sanitary engineering and hydraulics for the governments of Argentina, Honduras and Nicaragua.

Edward J. A. Gain, on the basis of 20 years' service with the Sewers and Paving Section of the St. Louis Board of Public Service and, more recently, as chief of the Engineering-Design Department of the Metropolitan Sewer District, has been promoted to the newly created office of technical assistant to the executive director. A major problem facing Mr. Gain in his new position is the pollution abatement program of the Mississippi River and its relationship to the flood control activities of the Corps of Engineers.

Angelo A. Marcello has resigned as state public works director for Rhode Island to become general superintendent of the M.A. Gammino Construction Company of Providence, R.I. As the liaison between the president and various project superintendents, Mr. Marcello will be responsible for all company construction activities.

Peter B. Dyson, principal engineer of design with Louis Berger and Associates until his election last November to the offices of vice president and secretary, has now been appointed to the additional post of chief engineer.

L. J. Sverdrup, president of Sverdrup & Parcel Engineering Company, with offices in San Francisco, St. Louis and Washington, D.C., announces that the

(Continued on page 28)

TESTlab CORPORATION announces availability of an improved

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SOIL TESTING SYSTEM by Troxler Laboratories

Adaptable for all moisture and density measurements.

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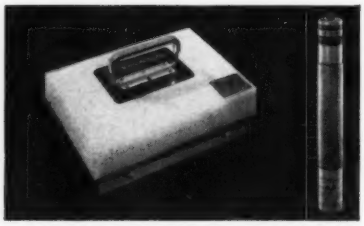
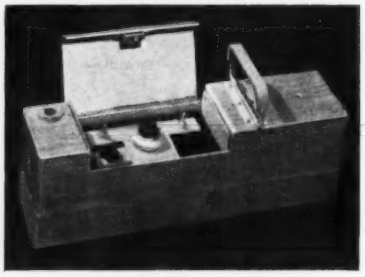


Surface Unit — Depth Probe

Ra:Be SOURCE MOISTURE



Ra:Be SOURCE SURFACE DENSITY UNIT (to 8″ depth)

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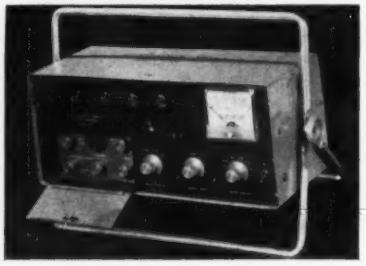

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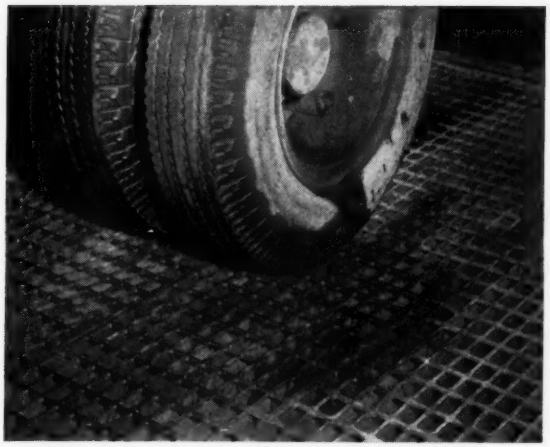
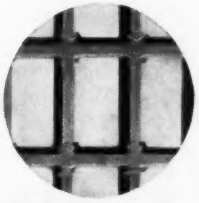


Heavy mobile loadings call for Gary HEAVY-WELD STEEL GRATING



Advanced design of Gary Heavy-Weld Gratings makes them ideal for any installation where heavy-duty open steel flooring is desirable. New design has the capacity to sustain heavy mobile loadings imposed by highway vehicles, lift trucks, and all classes of aircraft. Straight clean lines of the rectangular pattern permit unimpeded flowage and afford maximum open area. Wide range of sizes and meshes makes Gary Heavy-Weld Gratings adaptable for a variety of applications.

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- Aggregate screens
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- Vehicular ramps
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Grating Division, Gary, Indiana

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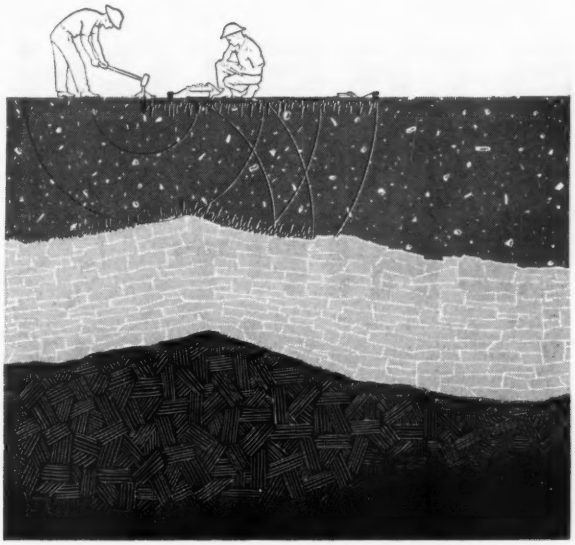

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This versatile instrument is currently available at **$750** F.O.B. Washington, D.C. *For additional information contact:*

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firm name has been changed to Sverdrup & Parcel and Associates, Inc. Officers include **John I. Parcel,** Hon. M. ASCE, vice president; **E. R. Grant,** executive vice president; **B. R. Smith,** vice president; **D. C. Wolfe,** vice president; **G. Wood Smith,** vice president; and **W. K. Cook,** vice president and chief engineer.

C. C. Jobe, active in general consulting work in Florida since his resignation in 1954 as project engineer for the Corps of Engineers on the construction of radar sites in Morocco, North Africa, has undertaken to serve Brevard County (Fla.) as county surveyor. Mr. Jobe was the founder-secretary of the Florida Section's Cape Canaveral Branch.

Robert A. Fosnaugh was recently promoted from design engineer for Harland Bartholomew and Associates, in Memphis, Tenn., to office engineer, with responsibility for all highway design performed by the Memphis office of Harland Bartholomew and Associates and Clark, Daily and Dietz. Mr. Fosnaugh has been with Harland Bartholomew since 1956.

Robert E. L. Johnson, who directed the recent comprehensive master plan survey of Houston's sanitary sewer system for Turner and Collie, of Houston and Port Arthur, Tex., and **Robert S. Braden,** a project and hydraulic design engineer with the firm since 1955, have been elected vice presidents of the organization. Mr. Braden, in addition, will serve as secretary.

J. E. Muzquiz announces the formation of Revilla & Muzquiz at 1811 East Hedges Avenue, Fresno, Calif. The firm will specialize in the planning, design and construction of commercial and industrial buildings, and facilities for the agricultural and packing industries.

Lucian J. Meyers resigned recently as chief of the planning branch in the Southern California District Office of the State Department of Water Resources. Mr. Meyers left the water resources department after 14 years to join the consulting engineering firm of Bookman, Edmonston and Gianelli, Los Angeles. He will be succeeded by the current head of the project development section, Supervising Hydraulic Engineer **Lloyd C. Fowler.** Mr. Fowler has been with the department five years.

David H. Curtis has established Curtis Engineers, specialists in industrial and commercial design, at 10 West First South, Salt Lake City, Utah. He was formerly president of Thomas & Curtis, Inc., in the same city.

Harvey O. Banks, vice president of the San Francisco, Calif., consulting firm of Leeds, Hill, and Jewett, and former director of the California State Department of Water Resources, will conduct an advanced graduate seminar in water resources development at the University of California during the 1961 Spring semester.

(Continued on page 101)

. . . . . Am-Soc Briefs

▶ ▶ To engineers and their families fed up with winter (and who isn't?) the Phoenix Convention, set for April 10–14, is a logical opportunity to enjoy a vacation in sunny Arizona, where April temperatures of 75 degrees are the rule. To make sure that the distaff side gets a chance to relax, too, the Convention committee has arranged to have responsible baby sitters ready to take over — for a fee, of course. . . . For members (and the ladies, too, if they wish) there is a very special Glen Canyon–Grand Canyon post-Convention trip. . . . For a refresher on the Convention, see the February issue (page 62) and the current issue (page 68).

▶ ▶ Of far-reaching consequence is the Conference on Environmental Sanitation, to be held at Northwestern University's Technological Institute, Evanston, Ill., March 21–22. Serious problems of America's mushrooming urban areas will be tackled — such as water supply and flood control, air and water pollution, and handling of human, industrial, and atomic waste — with the emphasis on enlightened planning. Two ASCE Divisions — City Planning and Sanitary Engineering — are sponsors, along with Northwestern University, the Northeastern Illinois Metropolitan Area Planning Commission, and the U. S. Public Health Service.

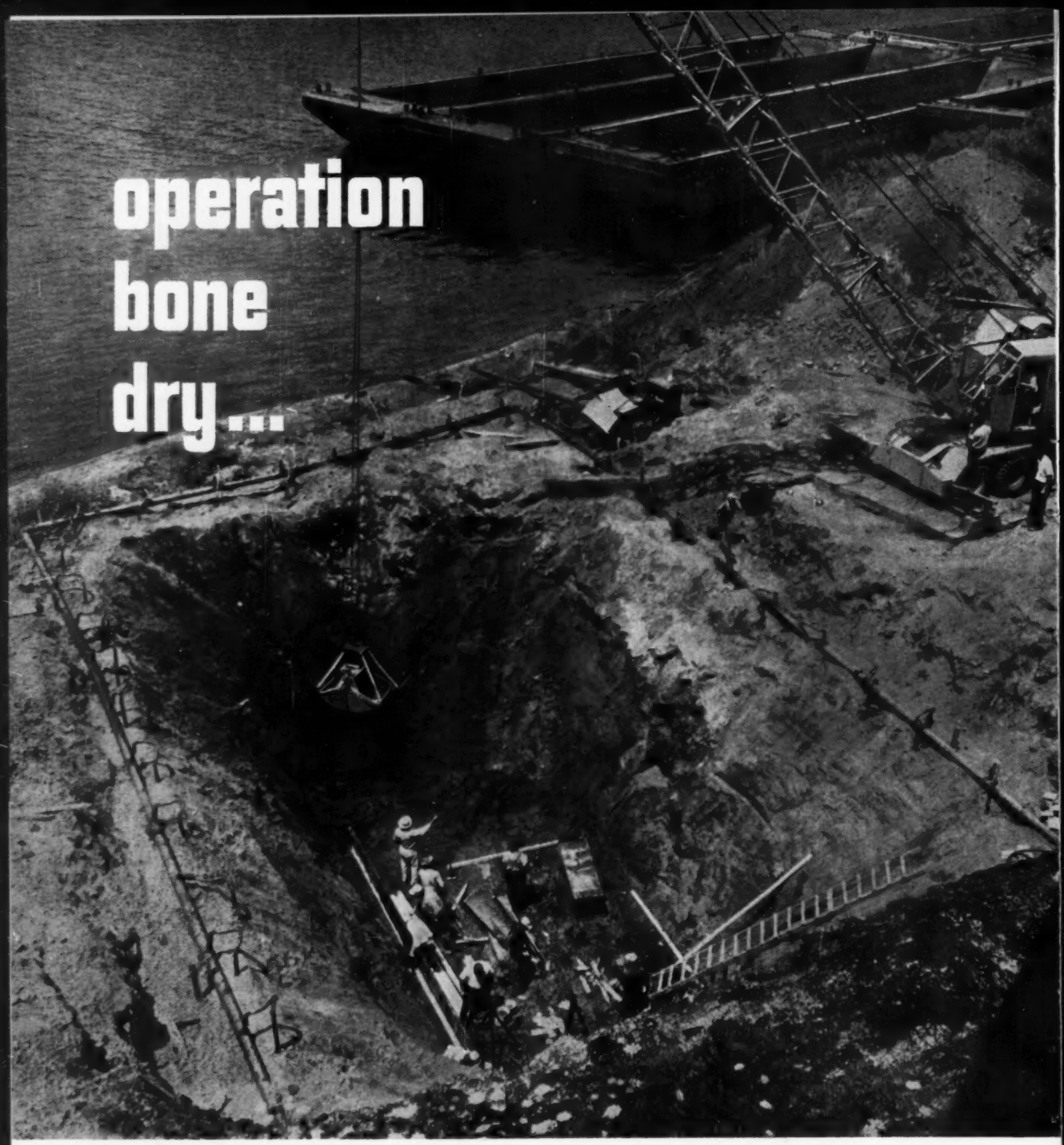
▶ ▶ Employment conditions survey. . . . In its next survey the Committee on Employment Conditions will include requests for salary information that will permit the presentation of age-salary analyses. This will greatly extend the value of the survey and the average engineer's interest in it.

▶ ▶ New York International Airport, in the vanguard of building to meet the needs of the jet age, has been awarded the 1961 ASCE Civil Engineering Achievement Award (page 46).

▶ ▶ Members are invited to send nominations for the recently established Professional Recognition Award — endowed by Edmund Friedman, F. ASCE — to the Executive Secretary. The deadline is April 1. The first award was made in 1960, to E. Lawrence Chandler, retiring Assistant Secretary of ASCE (April 1960 issue, page 88).

▶ ▶ Four or more annual scholarships, with top value of $1,000 each, will be available to Student Chapter members for the school year beginning September 1962. The scholarships are made possible by a $120,000 bequest to the Society by the late Samuel F. Tapman, F. ASCE (page 71).

▶ ▶ The Cumulative Index to ASCE Publications, the first such reference to Civil Engineering, Proceedings, and Transactions, is available. It is an 800-page book in an attractive hard cover of the same size as Transactions. A coupon for ordering was provided in the January issue (between pages 32 and 33).



GRIFFIN **Solves Another Dewatering Problem!** This river-bank pumping station job on West Virginia's Ohio River required speedy predrainage so foundations could be completed during low water level. A Griffin drive-casing sand-wicked Wellpoint system was installed (through silt, sand and clay layers) in 3 days. 48 hours later, pumping had dropped ground water 20' below the Ohio, and the bottom slab was poured . . . Further proof of time and money saving advantages of rapid installation and smooth operation of Griffin Wellpoint equipment.

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do you know that

U.S. iron and steel companies invested $1.48 billion in new plant last year? This outlay exceeded 1959 expenditures for construction and equipment by $543 million and was only $243 million below the record $1.73 billion spent in 1957. Outlays for development in the fifteen postwar years total a staggering $13.8 billion. Present plans call for spending $1.2 billion in 1961.

▪ ▪ ▪

Engineers' salaries rose about 5 percent per year in the 1958-1960 period? The good news is reported by the Engineering Manpower Commission of Engineers Joint Council, which has just completed its fourth biennial survey of engineering salaries. The overall median annual salary now stands at $9,600, whereas when the first survey was made (in 1953) the median salary was $6,500. Details of the survey will be reported in the April issue.

▪ ▪ ▪

The trend of half a century of stream pollution has been reversed in the Ohio Valley? In the states in which the Ohio River Valley Sanitation Commission functions 95 percent of the population is now served by treatment works. In 1948, when the eight-state clean-up compact was established, less than 1 percent of the population was served by sewerage systems. The dramatic change in the Ohio River sanitation picture is discussed in the Sanitation Commission's recent twelfth annual report.

▪ ▪ ▪

The Russians have developed a concrete that uses cotton waste as a substitute for cement? Despite the fact that cement is both cheap and plentiful in the Soviet Union, scientists report that cotton waste has other advantages. Concrete made with it, for instance, is said to be seven times stronger than conventional concrete. Our thanks for this to the January issue of *Rock Products*.

▪ ▪ ▪

The government will spend about $9.1 billion for research and development in fiscal 1961? The heaviest share of the funds will go into defense-related studies of all kinds. However, considerable attention will also be given to research into oceanography, weather modification, U.S. Geological Survey activities, and other areas of interest to engineers.

Water main breaks are not caused by old age? The New York City Department of Water Supply, Gas and Electricity attributes recent breaks in large water mains in use for many years to blasting in connection with construction in one case, and to steady vibration from a near-by subway line in another. Replacement of large city mains in use for fifty years or longer would cost more than $100,000,000 and do little to prevent breaks, the Department says.

▪ ▪ ▪

It is better to bury radioactive waste deep in the ground than to dump it in the sea? This is the consensus of a recent conference of oceanographers from ten nations, reported in Purdue University's *Sanitary Engineering News*. As the 150 experts see the situation, "It is the only way to isolate the waste from the living world."

▪ ▪ ▪

Swimming pool business is big business in the U.S.? Last year 56,000 new pools were installed, and swimming pool builders estimate that the 1961 figure will be 70,000. With the many incidentals involved in pool use and upkeep, last year's investment in backyard pools totaled $700 million, and this year it is expected to be $850 million.

▪ ▪ ▪

Almost 2,000 American Standards are available? At its annual meeting in December the American Standards Association reported that 1,961 American Standards were currently in use. Over 800 of the invaluable guides to the right way to do things—from drafting to construction of missile-launching pads—have been developed in the past decade. ASCE is one of many professional societies participating in ASA work.

▪ ▪ ▪

There is a sharp drop in the number of students taking civil engineering? Registrations in undergraduate schools last fall showed a drop of more than 1,000—from 6,673 in 1959 to 5,635 in 1960. For the engineering student body, as a whole, the decline is very slight—only about 100 fewer than the 1959 registration of 67,000. In Canada there is an increase in registration in practically all engineering branches, with civil engineering the most popular curriculum of all—the increase is from 644 in 1959 to 779 in 1960. Figures are from the U.S. Office of Education and the Engineering Institute of Canada.

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Cheney Stadium, Tacoma, Washington. Owner: Pierce County and City of Tacoma; Designers: Anderson, Birkeland & Anderson; General Contractor: Earley Construction Co.; Prestressed members: Concrete Technology Corporation (all of Tacoma).

CIVIL ENGINEERING

The engineer and architect —as defendant

ROBERT B. JARVIS, M. ASCE, Partner, Nevius, Jarvis & Pilz, Attorneys and Counsellors at Law, New York, N. Y.

Engineers, architects, lawyers and physicians, among other professional people, always have been charged with a strict rule of responsibility as to third persons in the practice of their respective professions.

The courts, through the power of judicial decision, are defining, redefining and enlarging the scope and area of obligation of the professional man with respect to his acts and their impact on third persons. In part this has been brought about by a change in social thinking and in part by present-day needs.

Thus with the gradual passing in numbers of the country doctor, the local family lawyer and the local, self-employed architect and engineer—whose problems of design were of the day of the mule team and the Fresno scraper—there have emerged highly scientific, specialized teams of professional men engaged in vast, complicated and important enterprises. This is particularly true of the engineering and architectural professions. Here we have large firms employing literally hundreds, in some instances upward of a thousand engineers, draftsmen and others whose work product eventually is certified by the signature and seal of a licensed Professional Engineer or a Registered Architect.

Not only does this work product, in the form of plans and specifications, represent millions and often tens of millions of dollars of construction costs, but the building and use of the facility so created, designed and supervised by the engineer or architect involves, so far as his continuing liability is concerned, a vast number of people, not only in the construction of the project, but in its use for years to come.

Therefore it is only natural that the courts should examine anew with care the impact on others of the negligent acts of engineers and architects. This has been manifested in a steady, but ever increasing amount of litigation involving the two professions.

Why there is an increase in such litigation is a matter of conjecture. To the writer it is the price of the growth of these professions, the price of bigness of individual firms with the accompanying and ever expanding need for delegation of authority by the heads of such firms. Further, litigation has been to a degree engendered by arbitrary or erroneous decisions of engineers or architects empowered to render decisions under the provisions of construction contracts.

Whatever the reason, the fact is that more and more members of these professions are becoming involved in long and often costly litigation.

Three areas of legal exposure

There are at least three principal areas of legal exposure. They are:

1. Liability to the owner for defects in plans and specifications and for negligent supervision of construction.
2. Liability to third persons for personal injury.
3. Miscellaneous types of liability.

The first of these three areas of liability is discussed here, following comments on a few basic principles. Items 2 and 3 will be covered in a later issue.

The weight of authority on this subject, that is, the general rule, is clearly expressed in a Michigan court[1] opinion written in 1898, where the following trial court's instructions were approved on appeal:

"A person who holds himself out to the public in a professional capacity holds himself to be possessed of average ability in such profession, and the law implies that he contracts with his employer (1) that he possesses that requisite degree of learning, skill, and experience which is ordinarily possessed by the profession in the same art or science, and which is ordinarily regarded by the community, and by those conversant with that employment, as necessary and sufficient to qualify him to engage in such business; (2) that he will use reasonable and ordinary care and diligence in the exercise of his skill—in the application of his knowledge—to accomplish the purpose for which he is employed; (3) in stipulating to exert his skill and apply his diligence and care, an architect, like other professional men, contracts to use his best judgment. . . . If . . . [the architect] ma[kes] any mistakes by which the . . . [owner is damaged], and it was through negligence or from incapacity, he is liable . . . If, from a mistake growing out of the exercise of his best judgment, he possessing the reasonable degree of learning, skill, and experience in his profession required by law or implied by law, then, in such case, he . . . [is not] liable for any damage resulting therefrom."

The cases are numerous in support of the foregoing proposition.[2]

On the other hand, the minority rule, to paraphrase the court decisions, is that an engineer or architect is bound to furnish plans and specifications such as would produce, if followed, a building of a kind called for, without marked defects in strength, character or appearance. In other words, the engineer or architect impliedly warrants the sufficiency of his plans and is liable for breach of warranty if the building, constructed in accordance with those plans, is not reasonably fit for the use for which it was intended.[3] It should be noted that in the cases following the minority view there is usually found an element of negligence, which of course would bring such situations under the general rule of responsibility.[4]

This entire matter of liability may be affected by the terms of the agreement of employment between the own-

er and the engineer or architect. For example, it is entirely possible for a professional man to promise that his services will be satisfactory. Accordingly, if the owner has reasonable grounds to find the services unstisfactory the professional man can be held liable without proof of negligence.[6]

In this connection, as well as generally, it should be kept in mind that if the engineer or architect prepares the contract of employment it will be construed most strongly against him.[6] Obviously professional people by agreement can assume any character or degree of liability that may seem proper to them under the circumstances then before them. However in this discussion of the liability of engineers and architects, no consideration will be given to the terms of any agreement of employment.

Liability to the owner

The subject of liability to an owner for defects in plans or specifications or for negligent supervision of construction can be divided into two parts: first, where the plans and specifications are prepared by the engineer or architect having a contract of employment with the owner, and second, where the plans and specifications are furnished to the engineer or architect by his consultant and thereafter furnished by the engineer or architect to the owner.

By contract of employment the engineer or architect implies that he possesses ordinary skill and ability which he undertakes to exercise reasonably, promptly and with a reasonable exactness of performance. The degree of skill required is such as would produce a facility or a structure of the character called for without substantial (as distinguished from trivial) defects in strength, appearance or other features of construction.

In other words, he is not an insurer of the accuracy or perfection of his work. Where he has exercised reasonable care, skill and diligence he cannot be held liable to the owner or third party.[7]

However, when he does not possess or exercise the required care and skill, he will not only be liable for any defects in his plans but also he will not be able to recover compensation for services.

Stricter interpretation foreseen

The writer believes that during the next few years the courts, particularly with respect to claims of plaintiffs other than the owner, will tend to require of engineers and architects such a strict degree of perfection and foresight that almost any lack of judgment or skill will be deemed negligence or a breach of a duty.

Where an owner brings an action against an engineer or architect, the owner must allege and prove negligence in the furnishing of plans, specifications or drawings that were defective (which the builder substantially complied with), and that in consequence of such compliance damages were sustained by the owner.[8]

Thus in an old New York case[9] the architects sued to recover their fee. The owner counterclaimed for damages to correct an inadequate chimney. The case was originally tried before a referee who held the architects were not liable as they were not experts in steam heating. On appeal, reversing the lower court, the Appellate Court wrote:

"[The architect] is an expert in carpentry, in cements, in mortar, in the strength of materials, in the art of constructing the walls, the floors, the staircases, the roofs, and is in duty bound to possess reasonable skill and knowledge as to all these things; . . . It is not enough for him to say, 'I asked the steamfitter,' and then throw the consequences of any error that may be made upon the employer who engages him, relying upon his skill. Responsibility cannot be shifted in that way."

Again, in a Georgia case[10] an architect was required to reimburse the owner for the cost of correcting a negligently designed foundation.

Further, for example, there have been suits against architects for defective plans involving plumbing, applied stucco to buildings, a collapsed grandstand, settling foundations, improperly designed stairs and improperly designed ceilings. The list could be continued on and on.[11]

In a recent (1959) case in Oregon[14] architects after settling a suit against them for negligent design and supervision brought an action against their insurance carrier for reimbursement. The negligent act of the architect was the use of steel pipe in a heating system, which corroded, causing damage to a hospital building. The insurance carrier unsuccessfully urged that the architect had the right to rely upon the representation of the manufacturer and upon approval of the heating engineer employed by the architect. The court in holding the carrier liable quoted extensively from the New York case[17] where the unacceptable answer of defendant architect was "I asked the steam-fitter." This Oregon case points towards a broadening of the area of liability of engineers and architects.

As to the matter of supervision causing loss to the owner, the owner must prove, if he is to prevail against the engineer or architect, that the engineer or architect was negligent or showed bad faith in the performance of his duties.

Other examples of omissions in connection with supervisory duties are found in the issuance of certificates upon which progress payments and final payments are based,[12] checking to see that the building is going up in accordance with plans and specifications[13] and performing the duties assigned by the contract so that the building goes up smoothly and with a minimum of confusion.[14]

The degree of care required of the engineer or architect as supervisor again depends on all the facts surrounding the events which are the subject of the suit. Whether or not there is negligence in a particular case is a jury question.[15]

Architect's duties discussed

For an example of the care required, reference is had to a fairly recent New York case (1956)[18] where the plaintiff school board brought an action against a contractor and the board's architects to recover the cost of repairing or replacing a gym ceiling because of a failure of the contractor to follow the plans. The Board recovered against the contractor only. In discussing the architect's duties the court said:

"The provisions of the contract relating to the supervisory duties of the architect are quite general, certainly neither specific nor precise. The evidence established that by custom and practice weekly attendance and inspection by architect during the course of construction met this 'supervision' contractual requirement. While it is true that a daily or more frequent attendance and inspection might have disclosed the omission of the felt, it is undisputed that the obligation to supervise was met and discharged when architect made adequate weekly supervision. Under this provision of the contract it was not necessary for the architect daily to inspect and supervise the progress of the construction, Major v Leary, 241 App. Div. 606, 268 N.Y.S. 413. The plaintiff has failed to establish by a fair preponderance of the evidence negligence on the part of the architect sufficient to constitute a breach of this provision of the contract."

The usually stated measure of damages in an action to recover for an engineer's or architect's negligence is the difference between the value of the structure, as designed and constructed, and what it would have been worth had it been properly constructed[19] or what would fairly compensate the owner for the loss sustained.[20] Where the defect may be corrected without great trouble, the damages for which the engineer or architect is liable may be fixed at the cost of such correction.[21]

It has been held[23] that loss of rentals due to delay in occupying a building is too remote and speculative to be considered. However, there might be a different answer if the question should come up in a metropolitan area under conditions where, for example, the engineer or architect, aware of the need for timely completion, negligently delayed delivery of plans, approval of working drawings, materials, etc. This is particularly true where the construction and financing are a "package deal" and prompt beginning of the rental period is a necessary part of a successful venture.

Financial obligations of engineer

In many instances the negligent oversight of the engineer or architect does not impose upon him as great a financial burden as might at first appear.

For example, let us assume that, through negligence, the engineer did not specify a boiler feed-water pump; that this fact was discovered during construction and that the engineer ordered the pump to be installed. The owner paid for the pump and its installation as an extra to the builder's contract, deducting the full amount thereof from the final payment due the engineer for his services.

While the engineer would have a financial obligation to the owner under the assumed state of facts it would be only a relatively small fraction of the total amount paid the builder by the owner under the extra order. First, the owner could not collect from the engineer the price of the pump because if the pump had been originally specified the builder would have had it in his price and hence there would have been no question about the owner paying for it. If, however, between award date and the giving of the extra for the pump, the price of the pump increased, then the engineer would be liable for the increase. Also, if the progress of the work was such that additional or corrective work was necessary to install the pump, or the wages of fitters had increased, then the engineer would be responsible for the additional costs so occasioned.

All the foregoing observations with respect to obligation and duty of an engineer and architect and their responsibility in connection with a pecuniary loss to the owner are applicable to situations where the basic fault lay in the work of a consultant employed by the engineer or architect who in turn was directly responsible to the owner.

Largely because of the demands of industry arising out of our scientific advances, for one person to master all the skills required to design all the components of a modern petro-chemical plant, say, would require more education and training than could be achieved in a single lifetime. Hence, when an engineer or architect is employed to design such a facility he must of necessity employ a number of consultants in specialized fields. Out of this situation arise the complex problems of the responsibility of the engineer for his consultants' negligence.

If we compare the engineering profession to the medical profession, we would find cases supporting the proposition that a professional man would be liable for defects caused by his failure to secure a consultant when the average and reasonably prudent engineer would have done so under such circumstances.[25] The difficult problem arises where the engineer does secure a consultant and, through no negligence of the engineer in selecting the consultant or approving his plans, a negligent defect in those plans causes a pecuniary injury to the owner. The very reason that the issue presents itself is that the engineer prefers to enter into a contract directly with the consultant in order to protect his exclusive relationship with the owner. He could avoid this by having the owner enter into the contracts with the consultants. Another way to avoid liability would be to expressly limit his liability to that of selecting a consultant and requiring the owner to look only to the consultant for the consultant's negligence. The writer questions the practicability of these suggestions.

A recent case in Oregon (1959)[26] has stimulated thought on this subject. In this case an architect contracted to furnish plans and specifications for architectural, structural, plumbing, heating, electrical, ventilating and other mechanical work for a large hospital. The heating was designed by consultants employed by the architect. A leak developed in the steel tubing as a result of the consultants' negligence in not providing expansion joints and sufficient anchors. Are architect and consultant liable? The court stated, in holding the architect and consultant liable, that the heating engineer was acting solely under the direction of the architect and the architect, by contract with the owner, was directly responsible for the design of the heating system. The court pointed out that a principal can be liable for the malpractice of his agent, assistant, or employee.

(This article, to be continued in the next issue, was originally given as a paper before a meeting of the American Institute of Consulting Engineers in New York, N. Y.)

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[13] Id. Arts. 13, 21, 38, 39.

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MOBILE-HOME PARK—

a new concept in "small city" planning

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City planning, small scale, for a population of 1,300, has been demonstrated by both engineers and architects in designing what is believed to be the world's largest luxury mobile-home park, the Mobil Country Club. Located at San Jose, Calif., the 508-unit community occupies a 45-acre site and cost $1,700,000.

Sites

To arrive at the most functional size of space to accommodate today's mobile homes, and to provide for future improvements and future expected length and width requirements, an extensive research program was initiated at a nationwide level among manufacturers of mobile homes.

Of the park area devoted to the mobile homes themselves, 70 percent was allotted to units of conventional type. Of these spaces, 63 percent accommodate trailers 50 to 60 ft in length; 22 percent, 60 to 70 ft; 10 percent, 70 to 80 ft; and 5 percent, 80 ft or over. Each space is 34 ft wide, made up of 10 ft for parking, 10 ft for the mobile home, 8.5 ft for a patio, and 5.5 ft of planter area. Each space contains a lawn area and a storage bin.

The remaining 30 percent of the area is reserved for expandable homes, which are rapidly gaining in popularity. These spaces are 40 ft wide, and have the same layout as those for conventional mobile homes except that the space allotted to the home is 18 ft wide, that for the patio 8 ft, and that for the planter, 4 ft wide. All mobile-home spaces are designed to provide ample parking area for two cars in the rear. Facilities provided for the 508 mobile home sites include laundry rooms, a major recreation building, offices, two retail stores, three service establishments (barber shop, beauty shop and dry cleaner), a service station, and a swimming pool. The utilities—water, sanitary and storm sewers, gas, telephone, electricity and television—are all underground.

The park is divided into blocks or islands, each containing an average of 18 mobile-home spaces of approximately 2,100 sq ft each, and bounded on all sides by paved streets. All islands are 100 ft wide, measured perpendicular to the streets.

All spaces are set at an angle to the street, providing easy access, a view toward the street and as much separation as possible from neighboring mobile homes, thus affording maximum privacy. One hundred spaces, each 12 by 20 ft, are provided; these are covered and used for the storage of small camp trailers, boats and cars.

Nearly all blocks and streets are curved. Certain streets, including all perimeter streets, are designated as primary arteries 30 ft wide, curb to curb. All feeder streets are 25 ft wide, an adequate width for vehicular travel, with parking entirely off-street. The curved streets, with the mobile-home pads set at a skewed angle to the street, provide the greatest vehicular turning radius with the minimum of street width. Spaces at the end of blocks are designed to accommodate extra-large mobile homes. Being at street intersections, these spaces provide easy turning movements for access.

Concrete curbs and gutters are of rolled type to serve as driveways along the entire frontage. Vertical-type curbs are used at block ends only. Reinforcing steel was used in the curbs because of heavy mobile-home loading. The design of plant-mix surfaced streets is consistent with the typical secondary street design in this area.

The parking and mobile-home areas have plant-mix surfacing on a rock base. The utility pad, base for storage bin, sidewalks and patios, are of concrete. Level patio areas required warping of adjacent areas for drainage.

Because of the relative flatness of the terrain, the method of alternate highs and lows was used to achieve grades necessary for the runoff of surface water to catch basins. Since lot grading and general utility construction started almost simultaneously, extremely close coordination was required between the grading contractor and the underground subcontractors.

Utilities

Uniform mobile-home regulations require manufacturers to place utility inlets at approximately the rear one-third point of the mobile home. This allows all utility lines to come out of a single utility pad on each individual mobile-home site. The lines provided are for water, gas, sanitary sewers, electric power, television and telephone.

This obviously created quite a problem of conflict among the various utilities, since all were to be underground and had to occupy a very limited area. After detailed studies of various possible layouts, it was decided to employ special trenching arrangements, each utility occupying a fixed location in the ground, the pattern being repeated from block to block. In general, storm drains and primary power lines are the deepest, sanitary sewers are next above, and water, secondary power, gas, TV and street lighting circuits are on top.

Since no adequate domestic water supply was economically available in the area, deep wells were drilled and a private water system was designed, utilizing a hydro-pneumatic tank for pressure control, and a cast-iron and steel distribution system. Water is pumped by two deep-well pumps with capacities of 1,000 and 500 gpm. The larger pump is primarily for meeting fire demands.

Detailed studies were made to determine the most practicable and economical methods of supplying electric power for the mobile homes, for street lighting and for pumping. The choice was between secondary or primary power furnished by the utility company at one central meter or at individual meters at trailer sites.

It was finally decided to use primary power delivered to a central meter and substations, with secondary distribution to the mobile-home sites. Individual meters were selected as being the most economical considering the long-term sale of power. Purchase of secondary power from the utility company was not feasible, since it would necessitate bringing in power from overhead at numerous locations around the park. Instead, power is purchased wholesale and is sold at retail to the customer. This type of installation is well adapted to underground construction as it utilizes direct buried cables and compact above-ground substation enclosures. Underground transmission and distribution, though more costly, was chosen for esthetic reasons.

Because of the flatness of the terrain, it was necessary to design a sanitary-sewer collection system that would afford gravity flow to a central pumping station, the entire station to be underground. Pneumatic ejector-type pumps were utilized at the station. From this location the sewage was pumped into a city-owned trunk line adjacent to the park.

Storm-sewer collection is by gutter flow to catch basins, through pipes to an underground pumping station, with ultimate flow into the nearby Guadelupe River. Pumping is necessary only when the river is at high stages. A system of gate valves and flap gates prevents river water from backing up into the system.

Centrally metered high-pressure gas is purchased wholesale and distributed at high pressure. Pressure-reducing valves are provided at each mobile-home site. Telephone lines run through underground conduits to each site and for television, a master antenna has been installed, with wires running underground to each mobile-home site.

Most of the work on the Mobil Country Club was performed during the rainy season. To shorten the construction time, schedules were tight, and timing had to be perfect to include the multitude of necessary details, and to prevent unnecessary delays.

There is every indication that mobile living will expand rapidly during the next decade. Mobile homes already have reached lengths of 80 ft and widths of 20 ft. Parks are getting larger and promise to become true "mobile cities" as the demand for this kind of housing grows. Already more than four million Americans have adopted this way of life, in some 14,000 mobile-home parks in all fifty states. The requirements of this new kind of American community are special and in many cases unique, and we engineers will be called upon to use our ingenuity to meet the need.

The Mobil Country Club, in San Jose, Calif., opened in 1960, is owned by Charles and Ted White and was designed by the San Francisco engineering firm of Wilsey, Ham & Blair. Fred Marburg was the architect for the job and K. S. Oliphant was Consulting Mechanical and Electrical Engineer.

Typical row of mobile home spots—just following completion of construction and before landscaping—shows street on curved alignment, asphalt trailer and car parking areas, and concrete patio-pads. Street lighting system uses pole-mounted incandescent fixtures controlled by time clocks.

Typical utility service stand for each mobile-home site includes, from left to right: sanitary sewer lateral, water service with hose bib, gas service with pressure-reducing valve, electric power service, telephone outlet, and TV connection to master antenna.

The completed community provides luxury living for its 1300 inhabitants. Battery-powered runabouts are used as service vehicles. Entrance to clubhouse is at right.

Tubewells for irrigation in India

ROBERT L. GAMER, Aff. ASCE, Engineering Geologist, United States Operations Mission to Turkey

Three thousand tubewells, recently finished in the Indo-Ganges Plains of northern India, brought to a close one of the world's largest programs of well drilling for irrigation.

These tubewells can produce more water than is sent to the San Joaquin Valley of California by the combined facilities of Shasta Dam and the Delta-Mendota Canal, major units of the Central Valley Project.

The tubewell program has increased urgently needed agricultural production in India. Because of favorable geologic conditions it provided irrigation water more quickly and cheaply than could have been done by storage dams and canals. The program also trained Indian nationals in modern techniques of tubewell construction. By creating a system of rural sanitary water supply, it improved the standard of living of thousands of Indian villagers and curtailed the spread of water-borne diseases.

The tubewells, jointly sponsored by the governments of India and the United States, lie within an 80,000-sq mile rectangular area in the states of Bihar, Uttar Pradesh, Punjab, and the former state of Patiala. Extending from Patna and Banares in the east to Agra, Delhi, and Amritsar in the west, the area is roughly equal in size and length to the combined territory of New England, New Jersey, Delaware, and Maryland, plus a connecting slice of New York below Albany.

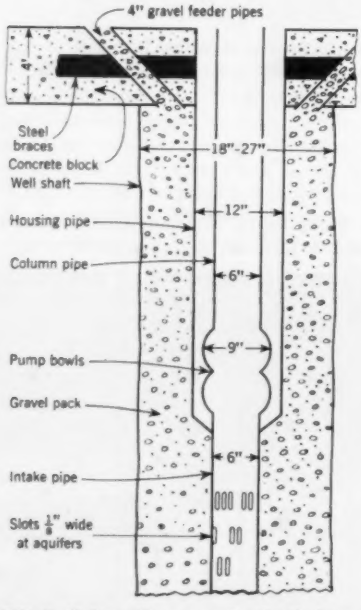


FIG. 1. Tubewells range in depth from 200 to 500 ft and in diameter from 18 to 27 in.

In round figures the tubewell project cost $45 million, of which about 18 million was financed by American foreign-aid funds and 27 million by the Government of India. American-financed funds were used to drill and equip the tubewells and to purchase transmission equipment needed to electrify them. The Indian money supplemented these funds and also went to build distribution systems and other works required for the project. Money spent on the program is to be paid back by the Indian states to finance other development projects in India.

The average tubewell in this area of India produces 675 gal per min (1½ cfs) or more at a drawdown of 25 ft or less. Only under special circumstances are pumping lifts greater than 50 ft. On an average, the water is lifted around 25 ft. A typical tubewell can place water anywhere within a tract of 1,000 acres, but can irrigate only about 400 acres of single-cropped, or 200 acres of double-cropped land in any one year.

Agricultural yields have gone up in areas served by the tubewells. For example, the yield of small grains is estimated to have increased about one-fifth of a long ton (448 lb) per acre over that produced by dry farming during a year of normal rainfall. During a drought year, the tubewell areas still produce good crops while the adjoining dry areas produce no crops at all.

About two-thirds of the tubewells were bored by foreign contractors. The rest were bored by agencies of the states of India, which either did the work themselves or had it done under contract.

The foreign contractors used the reverse-circulation rotary method for most of the drilling. This method proved well adapted for drilling clean holes and for making good progress in the fine alluvial soils of the well fields. It permitted the Indians to observe the latest type of drilling techniques. A modern tubewell design aimed at getting high production from fine sands was utilized. This design has been retained for other drilling programs under local sponsorship.

Tubewell design and construction

The design called for tubewells ranging in depth from 200 to 500 ft and from 18 to 27 in. in diameter (Fig. 1). A gravel envelope is utilized to hold the sands of the fine-grained aquifers (gravel aquifers are rare over most of this part of India). The hole is packed with fine gravel around a casing made up of an upper 12-in. housing pipe which is reduced below to an underhanging 6-in. pipe slotted to admit ground water. Most tubewells are slotted, with vertical cuts in the pipe ranging in width from ⅛ to 1/16 in. The pumpset is placed inside the housing pipe; both the housing pipe and the steel braces supporting it are embedded in a 4-ft concrete block forming part of the pumphouse floor. The tubewell is developed by overpumping until the water is free of sand.

The well house is designed to give sanitary protection to the tubewell. A floor 4 ft thick, surrounded by a waterproof shed, is placed above ground to prevent contaminated surface waters from draining into the well. The floor is made broad and thick to prevent waters percolating through the soil from seeping directly into the well shaft. In traveling along a devious path, the water is purified as it infiltrates into the tubewell.

Feeder pipes of 4-in. diameter, for gravel, are installed in the pumphouse floor. They permit replenishment of the gravel pack. This arrangement prevents troubles resulting from gravel depletion such as well caving and aquifer clogging, which occur when underground cavities are formed by pumping sand from the water-bearing beds.

Slots ⅛ in. wide proved more satisfactory than the narrower 1/16-in. slots.

This was found to be particularly true in tubewells that penetrate very fine-grained aquifers. The discharge from many of the tubewells with 1/16-in. slots fell off quickly, necessitating redevelopment. In areas underlain by unusually fine-grained aquifers, the most successful tubewells have 1/8-in. slots. Their development required a long period of time and the use of relatively large amounts of gravel. (See "Modern Water-Well Construction in California," Roscoe Moss, Jr., CIVIL ENGINEERING, Dec. 1958, vol. p. 918.)

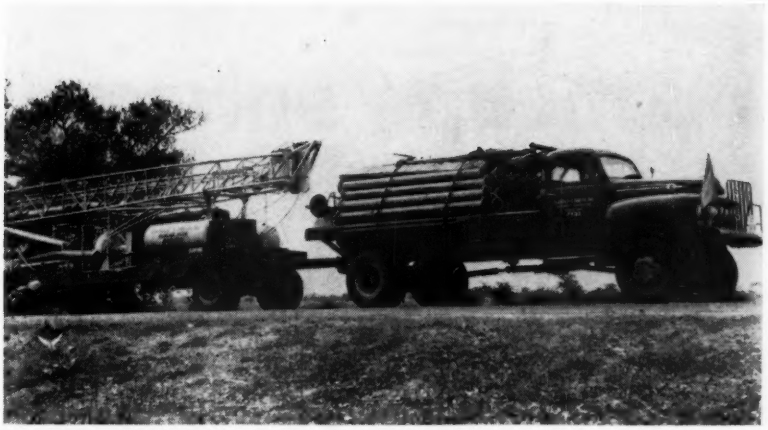
In contrast to foreign contractors, the states of India used many methods of drilling and constructed many kinds of tubewells. However, they eventually adopted the project design for most tubewells. The states used direct and reverse-circulation rotary, cable percussion and hand boring methods of drilling. They constructed tubewells of various types—gravel-envelope, cased, open-cavity, and others.

Some deep, large-diameter tubewells were drilled by hand. Through the use of percussion equipment adopted for hand boring, a 300-ft hole was sunk entirely by the power of human muscle. Drilling progress by this method was slow but under favorable geological conditions, hand-bored tubewells have produced nicely and cost little.

Turbine pumps have been installed for most of the tubewells. Because of complexities resulting from international exchange, the pump requirements had to be anticipated far ahead of the drilling, and consequently the combination of pump and tubewell was standardized. However, since the program started, the number of pump distributorships has increased, making it possible to fit the pump to the tubewell.

Appurtenant works

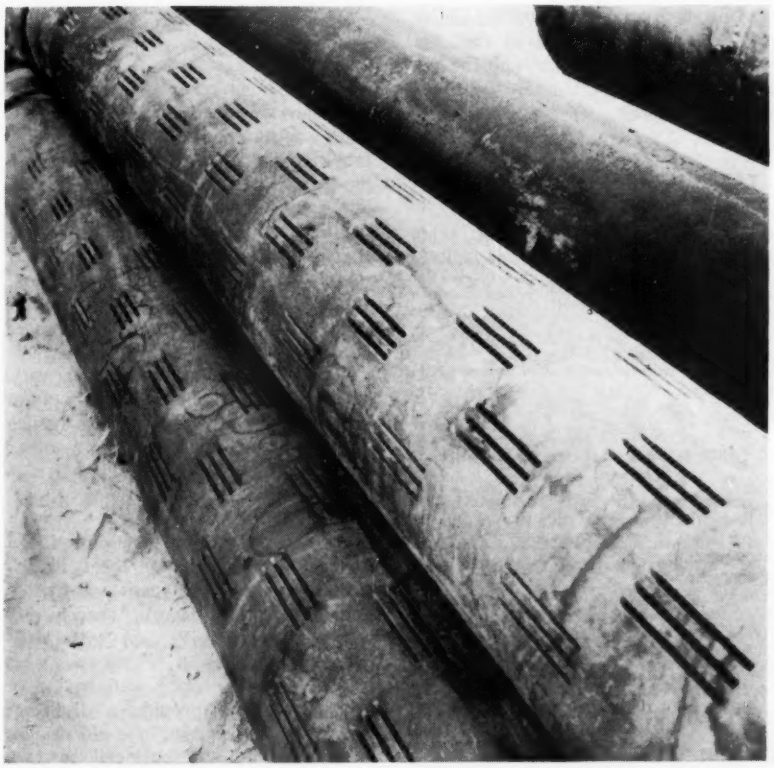
State irrigation departments were responsible for the design and construction of the tubewell appurtenant works. These works were ordinarily built by contract and included a pumphouse, a delivery chamber, and an irrigation channel (small canal) at each tubewell. At some tubewells they also included an operator's house, a bathing vat, and a storage tank for village water supply. See Fig. 2.



About two-thirds of the tubewells in northern India were bored by foreign contractors. Reverse-circulation rotary methods were used for most of the drilling. A typical rig is shown in travel position.

The appurtenant works were built of brick which, because of the availability of fine soils and the absence of gravel aggregates, could be manufactured more cheaply than concrete. A sturdily built pumphouse 12 ft square was designed to keep out marauders. It is provided with a 2-ft hole in the roof through which pump or pipe can be raised or lowered from a tripod. The hole is capped by a watertight manhole cover.

Design of the delivery chambers provides for stilling, desilting, and re-



Standard 6-in. intake pipe has 1/8-in. slots giving 22 sq in. of opening per linear foot.

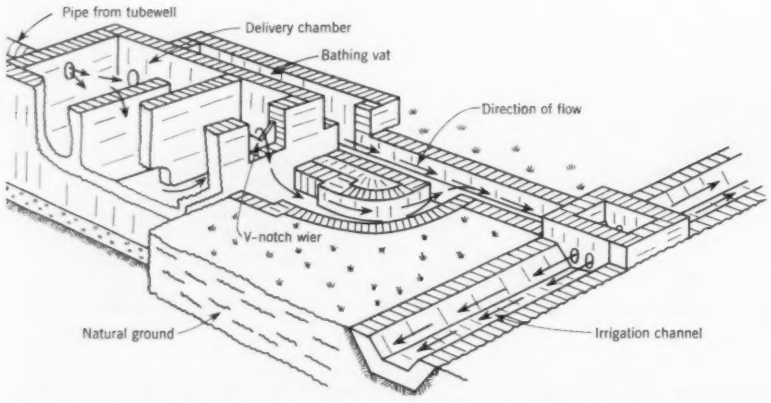


FIG. 2. Appurtenant works for each tubewell include a pumphouse, delivery chamber, and irrigation channel. Also included in some installations are an operator's house, a bathing vat, and a storage tank for village water supply.

leasing the water into the irrigation channel. A V-notch wier, graduated to furnish instantaneous flow measurements, is installed at the main outlet.

The tubewells were drilled on high ground to permit gravity flow of water to the farm fields below. Most tubewells were provided with at least one mile of brick-lined irrigation channel designed to carry water at the rate of 1½ cfs.

In some villages a 6-ft by 3-ft bathing vat was built to provide the inhabitants with washing and bathing facilities. In such an installation the delivery chamber is designed so that the water can be diverted through the vat into the irrigation channel—thus bypassing the wier.

TABLE I. Breakdown of major tubewell costs*

Construction and equipment for tubewell	$6,000
Land acquisition, civil works, etc.	2,200
Electricl generation	2,000
Electrical transmission and distribution	4,000
Customs, miscellaneous	800
Total cost per tubewell	$15,000

*Calculated from a selection of representative tubewells.

TABLE II. Cost of items for a typical tubewell project*

Transmission line (per mile)	$ 2,700
Unlined irrigation channel (per mile)	200
Lined irrigation channel (per mile)	1,700
Delivery chamber	100
Pumphouse	170
Culvert, 20-ft	60
Inverted siphon, 10-ft	40
Water supply tank, 7,500-gal	630
Water supply tank, 2,000-gal	250
Bathing vat	90
Operator's house	320
Access roads (per mile)	80
Tubewell camp (unspecified size)	21,000

*Project costs in a typical Uttar Pradesh irrigation district.

At some of the tubewell sites storage tanks were built to furnish a supply of domestic water. Pipelines were laid to a public faucet located at the tubewell or in the village. Tanks having a capacity of from 1,250 to 2,500 gal were constructed in the small villages with a light demand. In larger villages, with a heavy demand, a 5,000 to 7,500-gal tank was constructed.

The tubewell plants are designed to receive electricity from major thermal or hydroelectric power plants, such as that now being constructed at Bakra Dam.

Tubewell costs

The average tubewell, without appurtenant works, cost roughly $6,000. With appurtenant works, including facilities needed to put water on the land, the cost came to about $15,000. See Table I. In addition to the cost of drilling and constructing the tubewell itself, items of expense included pumps, motors, starters, transformers, transmission lines, right-of-way, pumphouses, delivery chambers, water courses, culverts, inverted siphons, operators' houses, roads, bathing vats, water supply tanks, domestic outlet works, shops, irrigation camps (office and personnel housing), and other appurtenant works. See Table II.

Land preparation

Types of land preparation utilized to control the water on the fields include basins, border strips and furrow irrigation. The designs are mostly adaptations from Persian wheel irrigation methods, in which water is drawn from an open well by ox or camel power to provide a discharge up to 60 gal per min. The old designs were adapted and enlarged to take care of the copious tubewell discharges.

Large earth-moving equipment, so prominent in land leveling operations in the United States, is used only under special circumstances in India. Ordinarily the cultivator must do his own land preparation as his means are minimal and the size of his holding is small. The average farm is about an acre in size. Land preparation is largely done by hand or by animal power. Home-made scrapers, land planes, and V-ditchers are commonly used behind teams of oxen.

Arrangements for drilling, energization, water distribution, and promotion of proper water use had to be closely scheduled to bring a well field to irrigation status without undue delay. Coordination was a critically important element in the success of the work.

Successful irrigation was achieved most quickly by farmers with previous irrigation experience. Among the inexperienced, agricultural assistance at the level of the cultivator was required in adapting sound irrigation practices to local conditions.

Extension services, a vital need

Experience in India has shown that something more than the exploration, design, construction, operation and maintenance of the works is essential in developing a group of tubewells into a successful project. The individual requirements of the farms merit consideration, and engineering help is needed in land preparation and drainage. If the farmers are to benefit fully from such a project some sort of irrigation extension and soil conservation service is needed at an early stage to put a project on a sound operational basis.

Foreign drilling contractors on the job included Harold T. Smith of the United States; the German Water Development Corporation of Germany; the French Group of Drilling Companies, of France; and Associated Tubewells, Limited, of Britain. The largest subcontractor was Associated Tubewells, Limited, India.

Personnel of the U.S. Technical Cooperation Mission associated with the project included: A. N. Thompson, M. ASCE, Chief of the Water Resources Branch; O. H. Folsom, F. ASCE, his successor; David Stoner, M. ASCE, Irrigation Adviser; John W. Robeson, M. ASCE, Contract Implementer; and the writer. Clifford Wilson was Director; his deputy and successor was Howard E. Houston.

John Sherman Cooper was U.S. Ambassador to India, and Matthew J. Kust was legal adviser and contract negotiator for the U.S. Embassy during the conduct of this work.

Submarine aqueducts deliver water to Venezuelan islands

FRANK R. SHERMAN, F. ASCE, Vice President • **DAVID R. MILLER, M. ASCE,** Chief Engineer
Daniel, Mann, Johnson, & Mendenhall International, Los Angeles, Calif.

In a spectacular demonstration of modern techniques of submarine pipeline construction, two long aqueducts were recently pulled into place along the bottom of the Caribbean to bring fresh water to the parched islands of Margarita and Coche, off the north coast of Venezuela. In the face of difficult conditions in the open ocean, including strong currents and submarine rock excavation, a 30-in. pipeline was pulled 14.3 miles under water in just 18 days through water depths up to 110 ft. This pipeline, and a 6½-mile, 8-in. submarine line, constitute the key features of the $20,000,000 Margarita-Coche Aqueduct Program carried out by the National Institute of Sanitary Works of the Republic of Venezuela, officially the Instituto Nacional de Obras Sanitarias (INOS).

Since the discovery of America the Venezuelan Island of Margarita has been linked to legends of fabulous riches in pearls. Pearls were indeed abundant there, but fresh water was and is scarce, there being only four small streams on the island. These are practically dry during six months of the year.

The island of Coche has no source of water other than artesian wells yielding a brackish supply. These two islands, with another small island, make up the Venezuelan State of Nueva Esparta, which has a population in excess of 70,000 people. The islands, which lie to the west of Trinidad and north of the Araya Peninsula, are one of the important pearl and deep-sea fishing centers in the West Indies. In the past their water supply was obtained from a combination of surface reservoirs and wells. Recently water has been barged to them at a cost of a million dollars a year.

In the late 1800's it was proposed to construct a tunnel to Margarita through Coche Island, but no action was taken. Then the shortage of water became more acute and in 1942 a study was made to determine means of providing an adequate supply by pipelines, by barging, or by desalinization of sea water. Transportation of water by pipeline from a source on the River Carinicuao, near Cariaco, was recommended as the most economical plan. In 1958 the consulting engineering firm of Daniel, Mann, Johnson, & Mendenhall was retained to carry out a detailed study and design for submarine aqueducts to supply water to the islands.

Alignment studies

To determine the best route for the submarine aqueduct, a comprehensive hydrographic survey was made, using an electronic fathometer on a boat. Control for the survey was provided from shore triangulation stations using theodolites and two-way radios. Three lines were run along each route and bottom samples were taken using a sediment "snapper" sampler. The results were plotted and reviewed with the consulting geologists, the Geological Diving Consultants of San Diego, Calif.

After a tentative choice had been made for the final route, the geologists, using self-contained underwater breathing apparatus, checked the underwater features controlling the route and confirmed the selection, as shown in Fig. 1. For an economic solution it was found necessary to install two pipelines. The main line runs from Chacopata on Venezuela's peninsula of Araya to Punta Mosquito on the island of Margarita, a distance of 14.3 miles. Then, to serve the island of Coche, a second pipeline had to be run from Chacopata directly to Coche, a distance of 6.4 miles. See Fig. 1. The adoption of a scheme using two separate lines was made necessary by a deep submarine canyon which was found to exist between Coche and Margarita, making it impracticable to connect these two is-

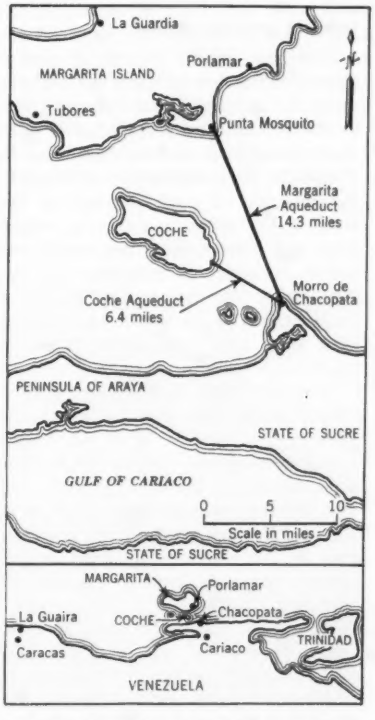
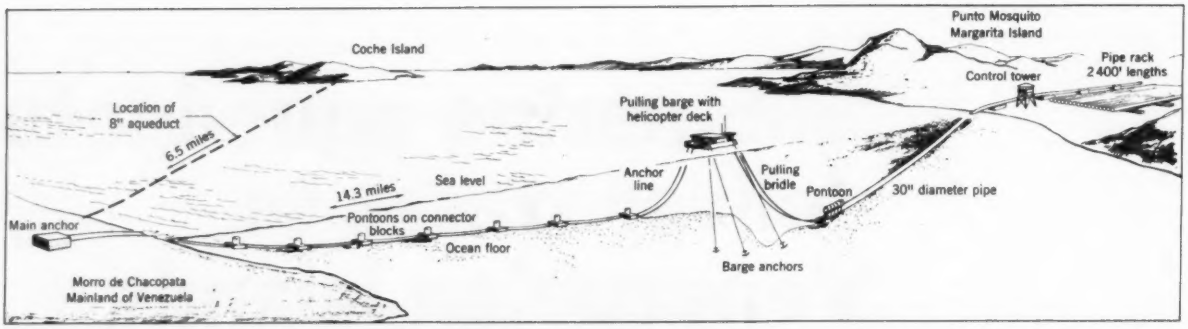


FIG. 1. Submarine aqueducts now transport water to the Venezuelan islands of Margarita and Coche. Inset shows northeast coast of Venezuela.



Pipeline was pulled along the bottom for the entire 14.3-mile route. Maximum depth encountered was 110 ft. After each 2,400-ft pull the barge backed up, unreeling the pulling bridle from the main winch and reeling in the anchor lines on the stern spooling devices.

lands directly by submarine pipeline.

Next, a detailed study of geologic and current conditions was carried out along the final lines. Diving geologists swam or were towed over the entire length of each line, and detailed notes were recorded while the geologists were on the sea floor. In addition, representative samples of the rocks and sediments encountered were secured, and at key locations the sediment thickness was sounded using a high-pressure water-jet pipe. Underwater photographs of typical subaqueous rock outcrops and sediments were taken to furnish the designer, and ultimately the contractor, with visual impressions of the sea floor.

Detailed geologic studies

The line to the island of Coche passes over what is predominantly a rocky bottom for about three-quarters of the route. The remainder is over shelly sand and cobbles. The line to Margarita also encounters a substantial amount of rock, except in the area of the submarine trench, where sand and finer-grained sediments are found. In order to properly bed the pipe and secure the required grades, a considerable amount of subaqueous sand and rock excavation was required.

Oceanographic studies with floats, a current meter and dye—with indirect geological evidence such as ripple marks and gravel streaks—showed a predominantly westerly current system having velocities ranging from 0.5 to 1.8 knots at the surface to 0.1 knot at the bottom in deep water. Under storm conditions, currents of scouring velocities may be generated along the bottom. Therefore the line would have to be anchored.

Concurrent studies of population and consumptive use by INOS indicated that 11.4 mgd would be required to satisfy the demand for water on Margarita, and about 1.0 mgd on Coche. This necessitated an inside pipe diameter of 28 in. for the Margarita line and 6 in. for the Coche line. A lined and coated steel pipe was selected. That to Margarita has an outside diameter of 30 in., a ½-in. wall thickness, and a ½-in. cement mortar lining; for Coche a pipe 8⅝ in. in outside diameter, with a wall thickness of 0.322 in. and a ¼-in. cement mortar lining, was found sufficient.

A good-quality high-strength pipe having all-welded steel joints and meeting generally the 5 LX specification of the American Petroleum Institute was selected, with special chemical requirements limiting the carbon and silica contents to insure weldability. A yield strength of 52,000 psi was stipulated for the Margarita pipeline and 46,000 psi for the Coche line. The required pipe was supplied under a $1,313,484 contract by the Mannesmann Steel Company of Dusseldorf, Germany. The contract included delivery to Punta Mosquito on the Island of Margarita, where the pipe sections were to be lined and coated by the installation contractor.

A triple-wrap coal-tar enamel coating was chosen as the basic pipe protection, with an outer cement-mortar coating for weight and for protection from abrasion and marine organisms. A cathodic protection system, using sacrificial magnesium anodes, was planned to insure that the pipe would be adequately protected at all times.

The contractor for the $11,000,000 project was a joint venture composed of C. A. DeLong de Venezuela, Constructiones Collins de Venezuela and Tecnica Constructora C. A., operating as Consorsio C.D.T. The first two companies are the Venezuelan counterparts of two American companies that participated in the major Hyperion submarine outfall projects, recently completed in Los Angeles. The contract was executed on January 23, 1959.

A construction camp was established at Punta Mosquito on the Island of Margarita, from which the larger pipe was to be pulled. Pipe was sent to Margarita by ship and transferred to lighters for delivery to shore and then by truck to the storage site. Arrangements were made to barge to the camp all water to be used for the crew and for construction.

Pipe coating

The contractor set up a field shop for coating the two pipelines. The pipes were cleaned, primed and given a triple-wrap coating of Koppers 70B coal-tar enamel for corrosion protection. The enamel was reinforced with two layers of glass fiber and was given an outer wrap of pipeline felt. Some 826 tons of enamel were used for the two lines. The coating was checked for thicknesses and holidays; it was then given a coat of whitewash and delivered to the yard for the concrete coating.

An outer jacket of cement mortar 2 in. thick was applied to the pipe to protect the coal-tar coating from damage during installation and from abrasion and marine growth after installation. The mortar coating added needed weight to help stabilize the line.

Concrete was produced at a batch plant set up at the job site. Venezuelan Type II cement, of good quality, was used with crushed stone of ½-in. maximum size from a nearby quarry, and beach sand washed with fresh water. A strength of 3,000 psi at 28 days was required for the coating concrete; the contractor elected to use a mix yielding a strength of 4,800 psi at 7 days. No admixture was used. The coating was reinforced with a 2 x 2-in. steel wire mesh, 12 gage, which was hot-dipped galvanized.

Pipe in double-random length (about 40 ft) was coated in horizontal position by the use of steel forms open at the top to admit the mortar. Concrete spacer blocks supported the wire mesh. As the concrete was placed, the

forms were continuously vibrated with air-operated Vibrolators. After six hours the forms were stripped; the coating was inspected and repaired where necessary. Hunt-process white-pigmented curing compound was applied and the pipe left on the skid timbers for welding. Individual coated sections were weighed with Hydroscales.

Pipe lining

Both sizes of pipe were lined with cement mortar to protect the interior from tuberculation or other corrosive action. Sand and cement were used for the lining with 3 ounces of liquid Plastiment per sack of cement.

The 30-in. pipe was welded in strings 2,400 ft long in preparation for pulling. This length of string reduced the number of field joints to be made while the pipe was being pulled into final position. After completion of welding of the 40-ft lengths, each joint was X-rayed. The joints were coated and wrapped and a cement-mortar coating applied. The strings were then capped, air-tested, soap-bubble tested and placed in position for lining.

In preparation for lining, the interior of the pipe string was cleaned with a stiff wire brush. Lining of the 30-in. pipe was by the Centriline method. In this method the lining machine is moved through the pipe at a controlled speed. Mortar is forced into a rapidly revolving dispenser head, from which it is thrown onto the pipe wall by centrifugal force. Slowly rotating steel trowels follow directly behind the applied mortar and give the surface of the lining a smooth, hard finish. A constant volume of mortar is dispensed and the thickness of the lining is regulated by the travel speed of the machine. Since the lining was the last operation, it was the determining factor for buoyancy control. This was achieved by varying the thickness of the lining, which was generally 0.41 in.

Half of each 2,400-ft string was lined in a single operation; within 48 hours, the remaining half was done. Because of extreme daytime temperatures, the lining work was carried on at night. Lining was cured by closing the end of a 2,400-ft string and keeping the bottom 6 in. filled with water until the pipe was launched. The lining was done by the Centriline Corporation under subcontract to Consorsio C.D.T.

Lining of the 85/8-in. pipe for the Coche line was done by the more conventional process of centrifugal spinning of individual pieces. Some 170 of the 891 pieces of pipe were not sufficiently straight to line by the spinning method. These were lined by an initial application of mortar by a Centriline machine of small diameter, followed by spinning for just a few seconds. This supplemental spinning was enough to achieve a smooth finish yet not enough to produce an unequal thickness of mortar. The mortar lining averages 0.25 in. in thickness and has an average weight of 5.9 lb per ft.

After coating and lining, the 85/8-in. pipe, still in 40-ft sections, was transported to the Island of Coche. There the smaller pipe was welded into strings with field joints at every 40 ft in the lining, both inside and outside. The design provided for a solution to the problem of inaccessible interior joints by specifying plastic cylinders to be inserted at the joints when the pipe sections were put together so as to give a smooth, continuous lining.

The cylinders were inserted in the pipe sections as they were joined and each joint was welded directly over the plastic cylinder. A specially formulated epoxy compound was used for the cylinders to provide strength and resistance to the heat of welding. The epoxy was furnished by the Hastings Plastic Company and was cast into cylinders on the job. The cylinders were bonded to the interior of the pipe with an epoxy adhesive.

Some difficulty was experienced with the cylinders in the 85/8-in. pipe as they were only 1/4-in. thick and developed a tendency to crack under the heat of welding. This difficulty was corrected by lowering the welding heat as much as possible and by cutting a small groove around the cylinder immediately back of the weld.

Epoxy cylinders were also used to line the field joints between the 2,400-ft strings of 30-in. pipe. These cylinders, which were 1/2-in. thick, worked very well.

Submarine excavation and trenching

Both the Margarita and Coche aqueducts required extensive underwater trenching to provide a smooth grade and eliminate high points, which might permit accumulation of air. Trenching also provides protection and anchorage by burying the pipe below the influence of storms and currents.

As a prelude to the underwater work, the contractor moved a probe barge along the line, making probes at intervals with a heavy drill steel, and water under pressure, to determine the character of the material to be excavated. A dredge barge, having a 15-cu yd dragline bucket, was brought in to excavate the material indicated to be rock. A typical DeLong-type barge was used. It was equipped with "spuds," which could be lowered to the sea bed, and on which the barge could be raised clear of the water to stabilize it and hold it in position for dredging.

When material that was too hard to be excavated with the dragline was encountered, a spud-mounted drill barge equipped with three air-operated drills moved in to drill the area and blast the material for removal by the dragline. After the excavation was completed, the probe barge was converted to operate a submarine bucket, which was dragged through the trench to clean out loose material and even up the bottom.

In areas where no hard material was found, the contractor proposed to lower the pipe to grade after installation by the use of a Collins submarine trencher. This machine rides along the pipe and undercuts it by the use of high-pressure water jets, fed from a pump and compressor on a floating service barge. By repeated passes of the jet trencher, the pipe is gradually lowered to grade.

Installation

The pipe, in 2,400-ft strings, lined and ready for installation, was stored on wooden skids along the launchway. The skids were levelled with an instrument in order to minimize stresses in the pipe and the concrete coating. The launching units consisted of small steel frames to which a rubber-tired assembly was attached to permit the pipe string to roll smoothly over the units. Pipe was rolled onto these frames by eleven synchronized electric winches. Some 106 units were used, at a spac-

Diving geologists made design investigations by exploring the sea floor along the route of the pipeline to aid in the selection of the best alignment.

Launchway featured rubber-tired launching units. The 2,400-ft pipe strings were rolled into place by winches and then were lowered to the launchway units.

Submarine trencher, shown being lowered into place, straddles pipe and uses high-pressure water jets to remove material from under the pipe and bury it in several passes.

ing as close as 40 ft at the curves where the pipe left the shore.

Specifications called for a minimum negative buoyancy of 5.5 lb per ft for the 30-in. pipe. Partial buoyancy was achieved by keeping the interior of the pipe empty, the weight being controlled by variations in the thickness of the coating and lining since the large pipe section provided ample displacement. As mentioned previously, the contractor elected to install the lines by the submarine pulling method rather than by the use of lay barges. In the method used, the pipe sections are sealed off and, containing only air for partial buoyancy, are pulled along the sea floor to the opposite shore.

Pulling cables were laid from the launchway on the island to the main anchorage at Chacopata. This anchorage consisted of 12 short steel piles driven into the ground, connected by a steel frame and encased with concrete. The distance between the island and the mainland was divided into four parts and wire-rope cable ranging in diameter from 1¼ in. at the island end up to 2 in. was laid by reeling out from drums on the pulling barge. The cables were laid under range control using a precise theodolite, insuring accurate placement of the cable and ultimately of the pipeline.

A loop of 2-in. line, from the barge's powerful two-drum winch, formed a pulling bridle, which was placed around a large-diameter sheave block on a sled at the end of the first pipe string. Pulling was done with a barge-mounted Collins Seamaster winch, powered by a diesel engine through a torque converter. The double-drum unit is capable of pulls up to 1,320,000 lb at 25 fpm. Actual transmission of the pulling load from the winch to the anchor lines was accomplished through a pair of blocks and an eight-part line of 1¼-in. rope. The main purpose of the eight-part line was to break down the large pulling load so that one of the ropes could accommodate a dynamometer, which accurately indicated the pulling load.

A Collins Baymaster winch, with a capacity of 400,000 lb, was used to maintain tension on the landward end of the pipe at all times. After each 2,400-ft string was pulled, a clamp was attached to the end of the string and connected by a short cable to a standing hold-back anchor. In this manner, the cable from the hold-back winch could be disconnected and carried back to the end of the next string. The epoxy ring was next installed and the joint welded, connecting up the next string. The pulling barge would back up by spooling in on its anchor lines, just the reverse of the cable-laying operation. The pulling could then recommence after the field joint had been coated and wrapped.

In order to expedite the pulling, high-early-strength cement was used in the exterior joint coating, and this, together with an accelerator and a banded steel wrap, made it possible to resume the pull with a minimum loss of time. The average time required for making such a joint was three hours.

The pulling operation was controlled from a central control tower constructed at the highest point of the line. Radio communication was maintained between the tower and the pulling barge, the hold-back winch and the welding stations.

The contractor began laying the pulling cables on November 10, 1959, starting at Chacopata and progressing towards Punta Mosquito on the Island of Margarita. Cable laying was completed on November 14, 1959. The actual pulling commenced on November 19, 1959, and was completed on Sunday, December 6, 1959. Thirty-two strings of pipe, totaling 75,525 ft, were connected and the 14-mile-long string was pulled in 18 days. The maximum pulling load was 376,000 lb.

Coche Aqueduct

Pulling of the cables for the Coche Aqueduct was done February 26-29, 1960. Pipe strings for the smaller line were made up in 2,400-ft lengths on the island of Coche and the pulling of the first string began in the afternoon of February 29. Pontoons were spaced at 85-ft intervals, which gave a negative buoyancy of approximately 3.5 lb per ft.

Trouble with currents began almost immediately. After the second string had been pulled, strong currents forced the pipe out of alignment as much as 65 ft. Spacing of the pontoons was increased to 91 ft and the hold-back pull to 12,000 lb, with the result that the alignment improved. But the contractor had continued trou-

ble with currents, which tore off pontoons, and with rock slides in the trench. By the time string No. 9 was being pulled, the pulling load had risen to 220,000 lb, near the maximum allowable. An underwater inspection showed that the pipe coating had been damaged in a number of places. On March 12, the contractor made the decision to pull the line back with string No. 9 only half in the water. The pipe was then pulled back in two sections, one of 5½ strings and one of 3 strings.

Repair of the damaged pipe was completed on March 29, 1960. Some 70 pieces of pipe were repaired and five pieces of pipe, totaling 55 ft, were cut out and repaired. All strings were checked after repair by pulling a "pig" through—to bring out any broken concrete. Only one string showed a damaged interior; here a 2-ft length of pipe was cut out and the lining repaired. A second pigging showed the pipe to be satisfactory.

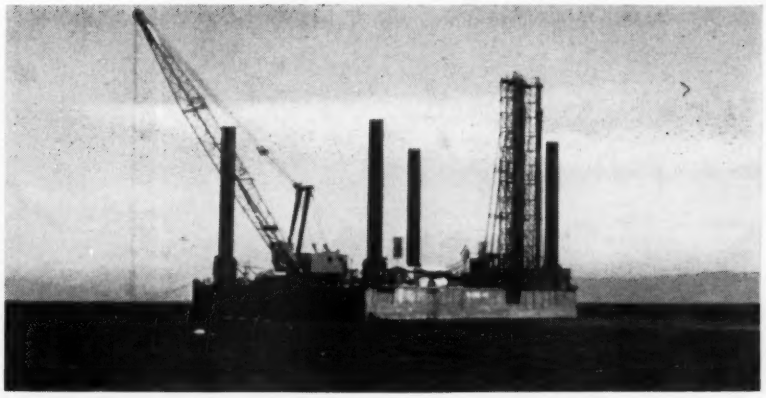
Second pull on Coche Aqueduct

To insure against a repetition of the difficulties encountered the first time, the trench was widened at critical spots and additional trench was excavated. The system of banding the pontoons to the pipe was changed to prevent pipe damage. Pulling was arranged so that pipe not used during the first pull would be the first to enter the water and the repaired pipe strings would be used last. In addition, the pipe used during the first pull was so placed on the launchway that what had been the bottom of the pipe on the first pull would be on top during the second pull.

Weather forecasts indicated good weather from April 1 to 8. Cable laying for the second pull was done on April 1 and 2. Pulling began on April 2 and was completed on April 7. Fifteen strings of pipe totaling 33,974 ft were pulled in 6½ days with a maximum pulling load of 180,000 lb. This is to be contrasted with the 220,000 lb used for the first pull of 8½ strings. The average pontoon spacing used for the second pull was 90 ft, giving an effective negative buoyancy of 5.7 lb per ft.

Cathodic protection

Cathodic Protection Service Company of Houston, Tex., under subcontract to Consorsio C.D.T., installed the protection system. An unusual feature of the project was the application of cathodic protection during construction. This temporary cathodic protection and testing did not interfere with the regular construction operations and provided an excellent means whereby any significant damage to the pipe coatings during installation could be instantly detected.



Drill barge was used for drilling and blasting rock and coral along the line of the aqueducts. Barge is equipped with three air-operated drills and a dredging crane.

The Margarita pipeline received cathodic protection from the moment it entered the water. By the time 20,200 ft had been pulled into the water, the current requirement had built up to 3.8 amp at a pipe to copper sulphate potential of 1.066 volts. Since there had been a gradual build-up in the current rather than a sharp jump, this indicated either that the coating appeared to be of poorer quality than expected or that there was a high-resistance short through the pulling head. Unfortunately there was no practical way of checking to see whether head leakage was the cause. At the end of the pull, the current requirement was actually less than the first value, being only 3.5 amp at a potential of 1.2 v, and when the pulling sled had been removed, the current dropped to 2.3 amp at 1.17 v. This indicated that there had been a high-resistance short through the lead and that the coating itself was of high quality.

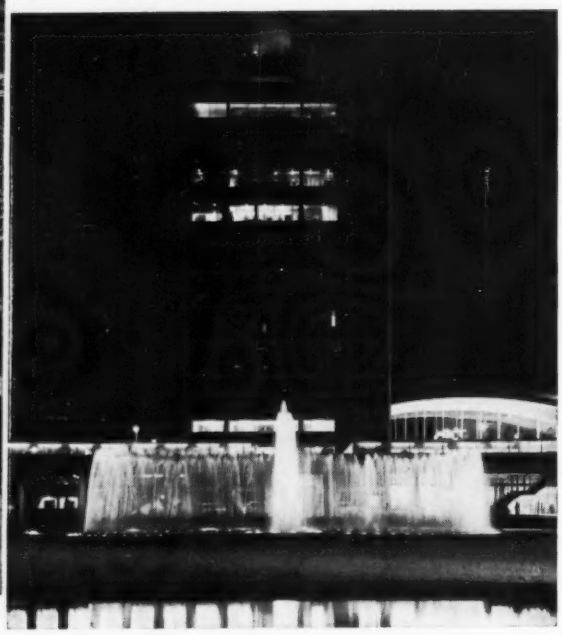
Before beginning the pull of the Coche pipeline, the pulling sled was inspected and tested. However, by the time the third string was in the water, the current had risen to 0.630 amp at 1.02 v, and at the ninth string, to 2.52 amp at 1.083 v. This again indicated a high-resistance short in the pulling sled. When the line was pulled back, inspection showed that a short had occurred through the buoy supports on the sled. This was repaired and corrective action taken and the pulling commenced a second time. At the end of the third string, the current requirement was 6.5 milliamp at 1.059 v. At the end of string No. 9, the current requirement was 46.0 milliamp at 1.064 v. Thus, for the second Coche pull, the temporary cathodic protection and test system performed exactly as intended, in accordance with the theoretical requirements, and made possible a continuous monitoring of the coating resistance.

The permanent cathodic protection system consists of three principal components: (1) the anodes, (2) the testing system, and (3) the insulating joints. The head of the cathodic protection system is the anode bed on the Chacopata Peninsula. The sacrificial anodes are of the magnesium type and are cast from Dow Galvomag alloy. Four anodes were installed for the pipeline to Coche and 10 anodes for the Margarita line.

The anodes were laid on concrete blocks at a depth of 1 m below the low-tide level. Testing stations were provided at Chacopata, on the island of Coche, and at the Punta Mosquito terminus of the line to Margarita. The two submarine pipelines have electrically insulated joints at each end. The joints consist of two Dresser Style 39 insulating couplings separated by a 1-m length of specially coated and lined steel pipe. The couplings have Everdur bolts and nuts and were coated with coal tar.

The project was carried out for the National Institute of Sanitary Works of the Government of Venezeula. Dr. J. A. Faria is the Chief of the Technical Department, with Dr. Elena Quiroba in charge of the Division of Aqueducts, and Dr. Arrigo de Finis as Inspector General. For Daniel, Mann, Johnson, & Mendenhall International, Frank R. Sherman, F. ASCE, is Vice President in charge of operations; David R. Miller, M. ASCE, is Chief Engineer and acted as Project Manager; and Layfayette Higgins was Resident Engineer. For the prime contractor, Consorsio C.D.T., Claude Horton, F. ASCE, was project manager and Russell Dumas was superintendent.

Terminal City, core of the airport, includes ten terminals.



Fountain plays in front of spectacular 150-ft-high control tower at International Airport. Metal plaque, citing the airport as winner of ASCE's Outstanding Achievement Award for 1961, will be affixed to second story of tower in forthcoming ceremony.

New York International Airport wins ASCE Achievement Award

New York International Airport has been named the outstanding civil engineering achievement of the year. At a meeting late in January the ASCE Executive Committee officially confirmed the selection of a jury of magazine editors, which had picked the huge and complex airport for the 1961 Civil Engineering Achievement Award.

The award is the second to be made by the Society in an annual series recently established to arouse public interest in civil engineering by recognizing an outstanding achievement. The first award, made last year, went to the St. Lawrence Project.

The award consists of a metal plaque, bearing the citation and the ASCE emblem. It is expected to be presented to the operator of International Airport, The Port of New York Authority, at a ceremony in late spring or early summer.

Other projects nominated in the 1961 competition were: The Niagara Falls Power Development, on the Niagara River; Portage Lake Bridge, linking Houghton and Hancock, Mich.; the Intelex Postoffice Building, Providence, R.I.; the Pan American World Airways Terminal, at International Airport; the Chase Manhattan Bank, New York City; the Dresden Nuclear Power Station, Chicago; the Hyperion Effluent Outfall at El Segundo, Calif.; the Geysers Power Plant, Sonoma, Calif.; Lloyd Shopping Center, Portland, Ore.; and Grand Isle Sulphur Mine, off Louisiana in the Gulf of Mexico.

Judging was based on three general categories: (1) engineering skill demonstrated; (2) evident engineering progress; and (3) value of the project to mankind. In the case of International Airport, most of the varied activities of civil engineers were involved, including air transport, city planning, construction, highway, irrigation and drainage, engineering mechanics, sanitation, surveying, hydraulics, soil mechanics and foundations engineering, and structural.

International Airport, work on which started originally about 20 years ago, became eligible for this year's achievement award because it was deemed 75 percent operational, in accordance with the rules of the competition. Some work is still proceeding at the airport to complete the present construction program.

New York International Airport is a unique complex, 4,900 acres in size. It is designed to handle nearly all the New York Metropolitan Area's international air traffic, half its domestic long-haul air traffic, and one-quarter of its domestic short- and medium-haul air traffic. By the end of 1960, a total of $233,000,000 had been spent on it by the Port Authority.

A total of 35 airlines operate in and out of International Airport—15 American airlines and 20 foreign airlines. Terminal City, the core of the airport, has a total of ten terminals. The runway and taxi system now includes five runways and seven miles of taxiways.

Test shell fails at design load

J. KARAKAS, former Graduate Student, and
J. B. SCALZI, M. ASCE, former Associate Professor of Structural Engineering, Case Institute of Technology, Cleveland, Ohio

Thin-shell structures have become an accepted form, and in the hands of capable designers they have behaved satisfactorily. However, since bigger and better structures are always being built, a word of caution is necessary to prevent failure, by elastic buckling, of a thin cylindrical shell structure.

Buckling is defined as a lack of equilibrium between the applied loads and the internal stresses developed in the shell. Elastic buckling is the term describing the condition when the structure buckles and the internal stresses are below the elastic limit. Plastic or inelastic buckling is the condition that exists when the internal stresses are above the elastic limit of the material. In both cases, a state of unstable equilibrium exists causing an uncontrolled collapse of the structure.

The currently recommended procedure for the determination of the critical elastic buckling stress is derived from Timoshenko's theory on the buckling of long cylindrical tubes under the action of uniform axial compression. This theory states that the critical buckling stress may be calculated by the expression:

$$\sigma\ (cr) = 0.6\ Et/r$$

where

E = Young's modulus of elasticity in psi
t = thickness of shell, in in.
r = radius of shell curvature, in in.

This expression agrees satisfactorily with the experimental values of cylindrical panels, loaded on the ends, provided the longitudinal and circumferential dimensions are approximately the same and that the central angle is less than 23 deg. When the central angle is increased to 114 deg, the experimental values are only one-half of those calculated by the theoretical expression above. For cylindrical tubes with a ratio of radius to thickness of less than 200, the experimental values are approximately 30 to 40 percent of the theoretical values.

The basic premise of the theory is that the shell remains cylindrical up to the instant of buckling; and at that point the strain of the middle surface is displaced radially in a sine curve. The imperfections in the dimensions and the change in radius are disregarded. The major difference between theory and prototype is in the method of loading. The prototype is subjected to gravity loads that produce changes in the geometry of the structure which are not considered in the present theory. As a result, the theoretical expression predicts a buckling stress that is considerably higher than that which is actually realized in practice.

This experimental research was undertaken at the Case Institute of Technology Laboratory to determine the range of error in the current theory and to point out the dangers in extending a rational expression. The test was specifically designed to develop elastic buckling at the critical stress predicted by the recommended theory. The geometrical proportions of the test shell were determined on the basis of using a fiberglass-reinforced plastic with a thickness of approximately 5/32 in. The other dimensions were: radius of curvature, 25 in.; length, 125 in.; central angle, 80 deg; and ratio of radius to length, 0.2.

The reinforced plastic was used because of its strength and elasticity. The tension coupons indicated a modulus of elasticity of 1.8×10^6 psi with an elastic range up to 6,000 psi. The ultimate tensile stress was 27,000 psi. Therefore the shell was designed to buckle elastically under gravity loads at a unit compressive stress of 6,000 psi. The corresponding tensile stress was 18,000 psi, which is well below the ultimate tensile stress for the material.

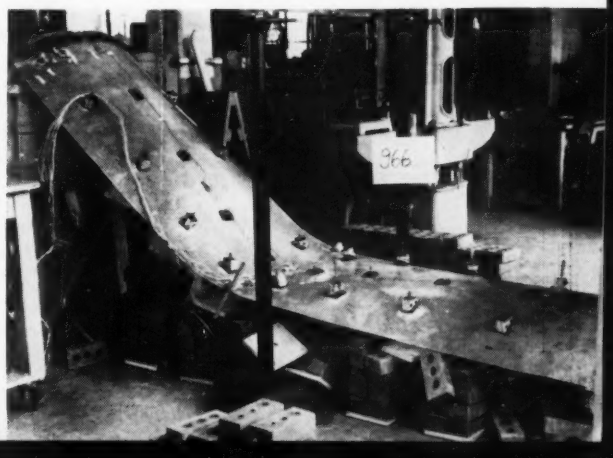
The design calculations were based on the usual sinusoidal loading distribution in the longitudinal direction and a uniform load per horizontal projection in the transverse direction. The actual loading was applied as a series of concentrated loads proportioned to simulate the theoretical loading in both directions. The total theoretical design load was calculated from the critical buckling stress to be approximately 2,900 lb.

The loads were applied by placing bricks on suspended platforms which were attached by rods to bearing pads on the top surface of the shell. The shell was simply supported by resting the end diaphragms on rollers.

The usual loading practice of incremental loading was followed in order to observe the behavior of the shell. Deflections and strains were recorded at each increment of load. The shell behaved as predicted for a small range of loading, then it suddenly collapsed. The total load that caused collapse was 966 lb. At this load the compressive unit stress at the center of the shell was approximately 32 percent of the calculated critical buckling stress. The collapse took place a short time after the load was applied, and strain and deflection readings were recorded. After removal of the load the shell was easily restored to its original shape. There were no visible cracks or evidence of damage to the shell.

The actual critical buckling stress agrees well with the recommended safe stress for design. Unfortunately, the test indicates that there will be no factor of safety against collapse as is assumed in applying the recommended value. The result of this one test indicates that more experimental and theoretical work is necessary to develop better theories for buckling of cylindrical shells. Until more complete theories are developed, it is suggested that designs be kept within the dimensional parameters of structures that have been built.

This article is a brief summary of the Master's thesis Mr. Karakas prepared at Case Institute of Technology. He has now returned to Turkey.



Fiberglass-reinforced plastic shell tested at Case Institute of Technology collapsed under a total load of 966 lb, at which the compressive unit stress at center of shell was about 32 percent of the calculated critical buckling stress. Need for further research in this field is clearly indicated.

The new expressway already operates at capacity but the mass transit capacity can be more than tripled by longer and more frequent trains. Also, additional tracks can be installed when need develops.

Chicago's rail rapid-transit line in the Congress Expressway

V. E. GUNLOCK, F. ASCE, Chairman, Chicago Transit Authority, Chicago, Ill.

Chicago's West Side Subway, more commonly known as the Congress Route, was opened for service on June 22, 1958. It is the first significant project in this country providing rail rapid transit in the below-street-grade right-of-way of a multi-lane expressway. Its opening climaxed years of planning and construction, requiring close cooperation among the City of Chicago, Cook County, the State of Illinois, the Federal Bureau of Public Roads and the Chicago Transit Authority.

A substantial part of the old Garfield Park rapid transit route, partly at street grade and partly elevated, was in the alignment selected for the Congress Expressway. The planners and administrators judiciously decided to replace the old rapid transit facility with a new route constructed within the right-of-way of the expressway, which is generally one block wide.

Placing rapid transit tracks in the right-of-way of the depressed Congress Expressway was a bold, pioneering venture for the cooperating public agencies. The project has attracted world-wide attention.

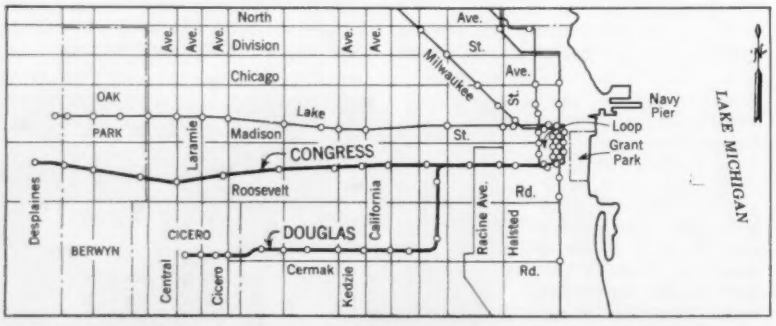


FIG. 1. Congress Branch of the Chicago Subway operates in the median strip of the new Congress Street multi-lane expressway. The Douglas Branch enters the expressway right-of-way as it nears the city.

Description of the route

The Congress route extends westward from a connection with the Milwaukee-Dearborn-Congress subway at the west bank of the Chicago River, near the central business district, through Chicago and Oak Park, and terminates at Desplaines Avenue, Forest Park, a distance of about 9½ miles. See Fig. 1. From the Chicago end, the new subway extension runs in twin underground tubes for ¾ mile, similar to the twin-tube construction of earlier Chicago subways. It descends a 3-percent grade to drop below the south branch of the Chicago River and ascends a 3.2-percent grade to emerge from portal openings in the median of the depressed right-of-way of the Congress Expressway, just east of Halsted Street. From Halsted Street to just west of Laramie Avenue, a distance of 5½ miles, the rapid transit line remains in the median of the expressway.

West of Laramie Avenue, the two tracks of the Congress Rapid Transit Route pass under the eastbound (south) roadway of the expressway

and continue westward along the south side of the expressway right-of-way to Desplaines Avenue in Forest Park. At this point the tracks recross the expressway roadways to the north side of the expressway and continue westward crossing above Desplaines Avenue into the terminal. There is sufficient right-of-way width to add two tracks between Halsted Street and Kenton Avenue (4¼ miles). Space for a third track is available between Kenton Avenue and the Forest Park terminal.

Sources of financing

From its connection with the Milwaukee-Dearborn-Congress subway to Laramie Avenue (about 6 miles), the new rapid transit facility was constructed by the City of Chicago with funds obtained from the sale of $25,000,000 of general-obligation bonds and $2,000,000 of revenue bonds.

City of Chicago expenditures of about $12,000,000 for fixed transportation equipment in this section are being reimbursed by the Chicago Transit Authority (C.T.A.) over a 30-year period. The new yard and shop facilities at Forest Park are being financed by the City of Chicago as a replacement for the C.T.A. yard at Laramie Avenue, which had to be abandoned. Using highway funds, Cook County and the State of Illinois are constructing and paying for the 3½-mile section between Laramie Avenue and the Forest Park terminal as a replacement of an operating utility.

Federal highway matching funds, made available to Illinois, and in turn to Chicago and to Cook County, contributed substantially to the financing of the right-of-way, of excavation and grading, of increased length of street overpass bridges, and of drainage. East of Laramie Avenue the C.T.A. contributed its right-of-way for the rapid transit and expressway project. West of Laramie Avenue, where the C.T.A. had acquired the tracks and other fixed transportation equipment from the now defunct Chicago, Aurora and Elgin electric interurban railway, the new transit facilities were provided as replacements. The C.A. & E. right-of-way in this area was purchased by the state and county for the rapid transit and expressway project.

Design features

There are 14 stations along the route, ten in Chicago and four in the Oak Park-Forest Park section. Seven of the permanent stations include auxiliary entrance-exit facilities serving adjacent streets, and one station has two auxiliary entrance-exit facilities. Station spacing averages 0.7 mile. All station buildings are at street grade, except at Central Avenue, where the highway and the rapid transit tracks are ramped over the local north-south street.

Like the State Street and Milwaukee-Dearborn-Congress subways, the extension is equipped with an automatic block-signal and brake-trip system. Supplementing these safeguards for train operation is a line supervisory control system which provides train dispatching and train crew contact at certain stations along the route from the C.T.A.'s main offices. Eventually telephonic communication will be provided between in-service trains and operations control headquarters.

Running rails are 115-lb standard AAR section, laid on treated oak cross-ties. Asbestos pads are used as an experiment to prolong tie life. Electric power is collected from a third rail of 144-lb section. Rock ballast is used to a depth of 18 in. Even the tube part of the new line is laid in ballast in contrast to earlier subway construction, where ties were embedded in concrete.

Forest Park terminal

Terminal facilities in Forest Park are designed to achieve the maximum in passenger convenience and operating efficiency. The facilities are to include a train repair shop and service buildings, a waiting room with convenient under-shelter facilities for off-street interchange of passengers between rapid transit trains and buses serving western suburban communities. "Park-n-ride" facilities, which can be expanded, are provided to serve patrons who drive to and from the terminal.

The initial terminal facilities are designed so that a combined multi-story garage and shopping center can be constructed, when funds to finance the project can be obtained. Preliminary planning contemplates a parking garage for 2,000 automobiles. Ultimate development may require a garage of 6,000-car capacity. Retail shops would be located at the first-floor level in the garage plaza. There would be direct, under-shelter connections with the train platform. This plaza area also would include short-time parking space for motorists who pick up and deliver "kiss-n-ride" patrons.

Operating features

Three rapid transit routes—Congress, Douglas and Milwaukee—have been combined into the West-Northwest Route, serving the west and northwest sections of Chicago by way of the central business district.

Both Congress trains (formerly Garfield Park) and Douglas trains operate to and from the northwest terminal at Logan Square via the Milwaukee-Dearborn-Congress subway and its connecting elevated structure. Douglas trains enter and leave the Congress expressway by an incline connection with the Douglas Park elevated structure at Loomis Junction, where an electronic system automatically identifies the trains and operates the switching mechanism.

During peak hours, six-car trains are operated. At present there is a 6-minute service interval on the Congress route and on the Douglas route during the morning and evening rush hours. From Loomis Junction to Logan Square the rush-period service interval is 3 minutes.

Running time on the Congress route from Forest Park to the central business district has been cut to 22 min. from 39 min. when the Garfield trains were operating at street grade between Racine and California Avenues. Average commuting time has been cut 8.7 min. Scheduled speed, including station stops, is now 26 mph. With standard equipment, the maximum running speed is 50 mph.

Agent's booth and passenger facilities are in building at street level. A well-lighted, enclosed ramp leads to canopied platform 600 ft long.

Park-n-ride facilities feature planned Forest Park terminal, which provides for train handling. Short-time parking space is provided for motorists who pick up and deliver "kiss-n-ride" patrons.

Test runs at more than 70 mph have been made with experimental high-speed cars.

The Chicago Transit Authority conducted a series of passenger traffic surveys during the spring of 1959 and 1960. Trip origin and destination, trip purpose, volume of passengers, station boarding and alighting traffic and other data pertinent to the travel habits of the route's passengers were obtained. The information was gained by the use of postcard questionnaires distributed to passengers entering stations and by counts of passengers at various points along the line.

Results of studies

From passenger counts and from surveys of passengers, these pertinent facts have been established:

Of the approximately 76,000 passengers traveling through Racine Station each weekday, about half (38,000) are carried on Congress A-trains and half on Douglas B-trains. See Table I. This balance of traffic results in equal scheduling of trains.

Patronage of the Congress A-branch appears to be steadily increasing. A station count made in the spring of 1960 indicates an increase of 11 percent in boarding and 6 percent in alighting in one year at all stations during the 12-hour period of heaviest use.

Revenue (fare-paying) passenger traffic for the five-month period January to May, 1958, compared with the same five months in 1960, reveals that in the outer sections of the line (from Central Avenue west), where all passengers received the maximum benefit of the faster ride, business has increased 64 percent. In the middle section of the line (Cicero to Kedzie), where less time-saving benefit accrued, originating revenue patronage has increased 55 percent. Altogether, there was 53 percent more revenue passengers on the Congress line than on the old Garfield route for the five-month period of the comparison.

Just how much of this increase is new traffic is not known. There has been some diversion of traffic from two other west-side rapid transit routes, Lake and Douglas. There has been an overall increase, however, in rapid transit traffic on the three west-side rapid-transit routes—Congress, Lake and Douglas—in this period of comparison, January-May 1960 over January-May 1958. An analysis of returns from the postcard questionnaire showed that in the 1959 survey, 7.1 percent of the respondents reported formerly using their automobiles; in the 1960 study, 11½ percent so reported.

Two-thirds of the total weekday travels occurs during the three-hour evening rush period. This high concentration of riding during the rush periods illustrates one of the major difficulties plaguing the transit industry today.

About 48 percent of the 10,000 respondents to 30,000 questionnaires reported that their trips started within the Chicago city limits. Some 32 percent reported trips starting in the Oak Park-Forest Park area, and the remaining 20 percent reported that their trips originated in 77 other communities. Respondents boarding at the Forest Park terminal originated in 41 suburban communities, some as far away as Elgin and St. Charles, a distance of 30 miles.

Nearly 43 percent of the trips ended in the 4-sq mile central business district, while 36 percent ended in the core of the central business district, an area of little more than one square mile. Some 83 percent of the respondents reported that their trips were to and from work; less than 3 percent reported trips for shopping or recreation. About half of the respondents reported that they walked to their stations; 33 percent rode to their stations by the C.T.A. or suburban buses; 16.5 percent drove or were driven.

Nearly 800 of the 2,055 respondents boarding at Desplaines Terminal reported that they drove or were driven to the station, which indicates the importance of park-n-ride and kiss-n-ride facilities at the outer terminals and outlying stations of rapid transit routes.

In a special survey in the west suburban area, 78 percent of the respondents (1,585 of 2,021) favored the construction of a park-n-ride garage at the Forest Park terminal. Of those responding to a question regarding the fee for all-day parking, 72 percent indicated a willingness to pay between 25 and 50 cents.

Checks of automobile traffic on the expressway showed it to be operating at a range of 90 to 105 percent of its design capacity during the peak hour, even though the west suburban section of the expressway was still under construction. During this same time, the rapid transit line was operating at about 30 percent of capacity.

The highway, costing approximately $10 million per mile, with four lanes in each direction, is carrying roughly 7,500 persons inbound during the morning peak hour and the same number outbound at night. The

TABLE I. Passenger Survey, Congress Branch

April 28 and 29, 1960

Period	A Trains (Congress)		B Trains (Douglas)		A & B Trains Comb.	
	To City	Out	To City	Out	To City	Out
6:30 a.m. to 9:30 a.m.	9,381	3,017	8,865	2,643	18,246	5,660
9:30 a.m. to 3:30 p.m.	3,750	3,067	3,538	4,006	7,288	7,073
3:30 p.m. to 6:30 p.m.	4,303	9,546	4,360	9,183	8,663	18,729
Total for 12 hours	17,434	15,630	16,763	15,832	34,197	31,462
6:30 p.m. to 6:30 a.m.*	2,034	3,133	1,873	3,011	3,907	6,144
Total for 24 hours	19,468	18,763	18,636	18,843	38,104	37,606

* Data developed from 1959 survey.

rapid transit line, costing less than $4 million per mile, carries about 10,000 passengers per hour in the heaviest direction during the morning and evening peak. Thus the rapid transit facility operating at less than 30 percent of capacity is already carrying over 1.3 times as many persons in the heaviest hour as the expressway which is operating at or near its design capacity.

The importance of rapid transit during the hours of heaviest travel is emphasized more dramatically by an analysis of a count of passengers entering and leaving the Chicago central business district, made in May 1960 during the annual Cordon Count. These data show that in a peak 15-minute period, the rapid transit line carries over twice as many passengers in the rush direction as the expressway—about 3,100 by rapid transit compared to 1,400 by automobile.

Good public acceptance

The new Congress subway has had good public acceptance and is gaining riders steadily, although it is not entirely completed and is still operating under adverse conditions. The construction of a multi-story garage at the Forest Park Terminal for park-n-ride patrons will increase the attractiveness of the route and will improve its patronage.

Presently operating at about 30 percent of peak-hour capacity, the Congress rapid transit facility has a vast reservoir of untapped passenger-carrying ability which can be used simply by adding more cars or more trains. This capacity can be further increased by adding more tracks.

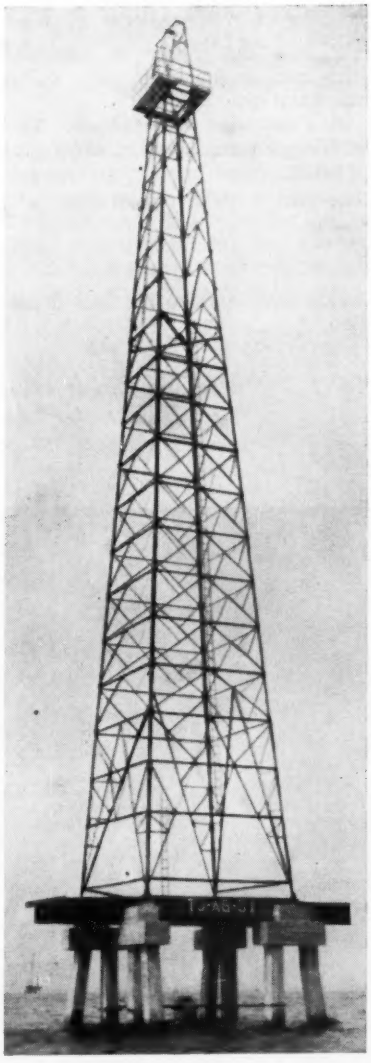
By combining rapid transit with the grade-separated Congress Expressway, the maximum in passenger transportation has been obtained for each transportation dollar expended. Passenger-carrying capacity has been increased three to five fold at a fraction of the cost of building a separate rapid transit facility, or an additional expressway.

In the acute peak period of travel to and from the central business district, the rail rapid transit in the Congress Expressway is more than twice as effective as the new highway in carrying people. Chicago plans more integrated facilities of this type when funds are available.

(This article is based on the paper presented by Mr. Gunlock at the ASCE Boston Convention, before a joint session of the City Planning and Highway Divisions, on "The Impact of Modern Rapid Transit Facilities.")

Concrete piles designed for marine foundations

E. G. PAULET, F. ASCE, Civil Engineer, Creole Petroleum Corporation, Caracas, Venezuela



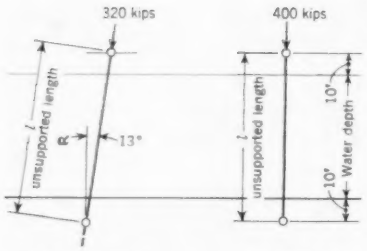
For a well platform in Lake Maracaibo, load on each pile is 100 tons.

More than 30,000 concrete piles of different sizes and lengths have been manufactured and driven by the Creole Petroleum Corporation in water depths as great as 110 ft in Lake Maracaibo, Venezuela. The oil development activities of this corporation in western Venezuela are nearly all in Lake Maracaibo, where the discovery of oil fields under deeper water has presented many challenging foundation problems.

The piles produced by Creole are of solid section, mostly square, with either parallel or tapered sides. The fabrication of solid-section piles is rapid and can be done with limited skilled manpower. Different pile sizes can be readily fabricated to meet a flexible drilling program.

In the early stages of oil exploration in Lake Maracaibo, the platforms for oil-well drilling and associated equipment were in shallow water and were built on creosoted timber piling. As water depths and drilling loads increased, the timber piling was replaced by concrete piles. The design of these piles followed the accepted rules of the time. The pile was regarded as a column having an unsupported length equal to the distance extending from the upper point of support to a lower point taken at the level the pile point reaches under the weight of the pile plus the hammer. While this rule was satisfactory for shallow pile penetrations, it was impractical for deep ones in soils of low shear resistance.

As the knowledge of soil mechanics advanced, the rule was revised. The level of pile restraint in the soil was taken as being at a distance of 10 ft below the soil surface. This is generally conservative and has been adopted in the design of most Creole piles since 1946.



(a) BATTER PILE (b) PLUMB PILE

FIG. 1. Driving conditions are shown for plumb and batter piles. During driving, piles are laterally supported at the deck of the pile-driver barge.

The design of the pile, as a column, had been in accordance with prevailing codes, but the long column formula in force seriously affected the economics of foundations for well drilling and other platforms. This necessitated a different approach to pile design. The design method that resulted has been applied to numerous piles of different shapes with proven success.

Foundations in the lake consist of plumb and batter piles. Once such plumb and batter piles are connected at the top, they act as members of a rigid frame within the foundation system. The simplest frame is that composed of one batter and one plumb pile, and this frame is generally used for each corner of the well foundation platform. The plumb piles are forced down with a 200-ton weight. The inclined piles are driven to a batter of 13 deg with a Vulcan OR hammer—a single-acting hammer with a 9,300-lb ram and a 3.25-ft fall. The plumb and batter piles were designed for an axial load of 200 and 160 tons respectively.

The basis of the pile design is illustrated in Figs. 1, 2 and 3. While it is being driven, the pile is regarded as a hinged-end column. It is subject to a mid-length moment, M_Δ, due to a final mid-length deflection, Δ, resulting from initial eccentricities (Fig. 3). These eccentricities are produced by:

1. End moments, M_i, caused by the eccentric application of the driving force P, acting at a distance e_w, equal to one-sixth of the pile diameter from the center of the pile.

2. The pile dead-load deflection, δ_d, if the pile is inclined. This is expressed as

$$\delta_d = \frac{5\ W \sin\alpha\ l^3}{384\ EI}$$

3. Non-homogeneity of materials. This mid-length eccentricity, e_h, is taken at $l/750$.

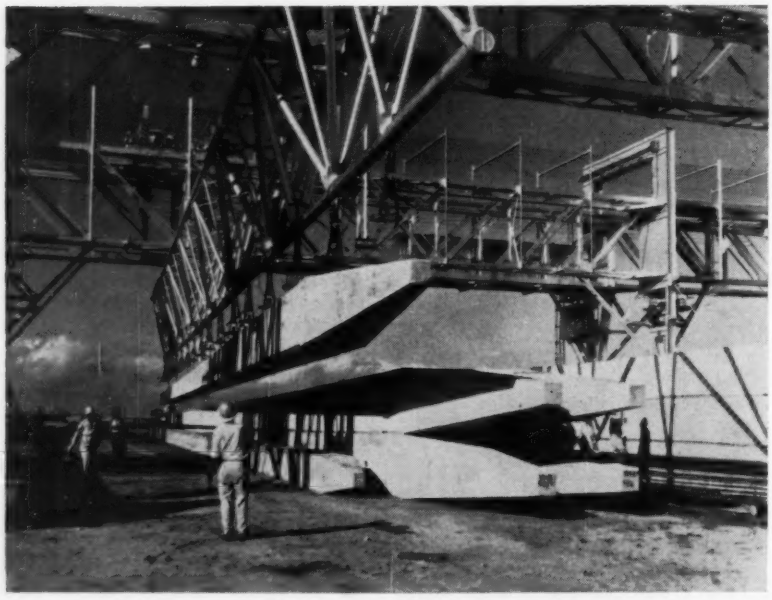
4. Fabrication crookedness. This mid-length eccentricity, e_c, is taken at $l/1{,}000$.

The sum of these eccentricities is δ, that is,

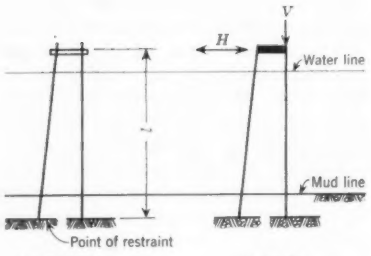
$$\delta = \delta_{M_i} + \delta_d + e_h + e_c$$

which contributes to the final deflection,

$$\Delta = \frac{\delta}{1 - \dfrac{5\ Pl^2}{48\ EI}}$$



Crane picks up a tapered pile 40 in. square and 174 ft long.



(a) PARTIAL (b) RIGID

FIG. 2. Plumb and batter piles are temporarily held during construction, then are rigidly connected at their tops with a concrete cap 10 ft above water. Fixed-end moments are assumed.

where E is the modulus of elasticity of the concrete, and I the moment of inertia of the section.

The total mid-length moment, M_t, equals the sum of M_Δ, M_i, *and* M_d, where

$$M_\Delta = P\Delta$$

$$M_i = P\,e_w$$

$$M_d = \frac{W \sin\alpha\ l}{8}$$

in which, W is the weight of the unsupported pile length l, and α, the angle of inclination of the pile.

Example

The application of this pile design method is illustrated in Figs. 4 and 5 and the deflections are worked out in Table I. The 32-in. pile width is located in the plane of the bent. The steel is symmetrically placed about axes 1-1 and 2-2. The average cross-sectional area of the pile is 820 sq in. The moment of inertia of the section at mid-length of the pile is 3.32 ft^4 about axis 1-1 and 2.10 ft^4 about axis 2-2. The modulus of elasticity of the concrete is 4,000 kips per sq in.

The condition for a pile battered at 13 deg is shown in Fig. 5. Here the driving force is 320 kips, and the buoyant weight of the part of the pile under water is 48.5 kips. The weight of the pile section above water is 8.54 kips. For simplicity, the sum of these two weights is used for computing the dead-load deflection and moment.

The ratio of design length to average diameter of the pile is 47. Therefore the long column formula given by the American Concrete Institute specifications will not permit consideration of this pile, as the ratio in the specifications is limited to 43.3.

The piles of 200-ton capacity produced in Creole's casting yard, which have ratios varying between 43.2 and

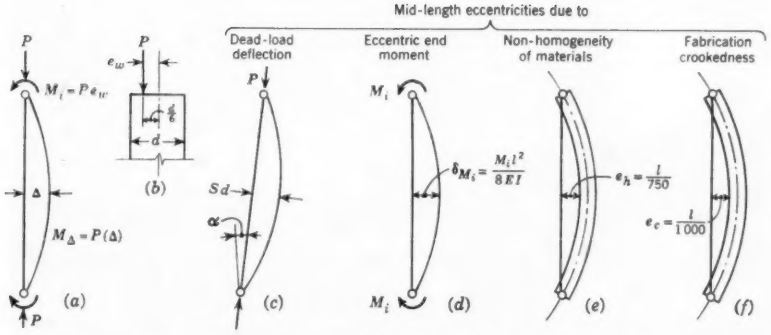


FIG. 3. Pile bending moments under driving conditions are illustrated. Formulas are given in text.

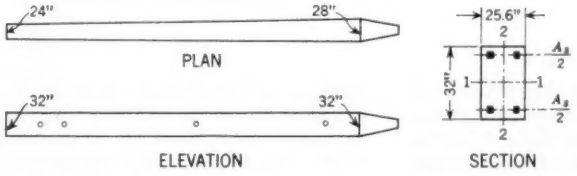


FIG. 4. A typical pile used by Creole has the section shown at the mid-water depth.

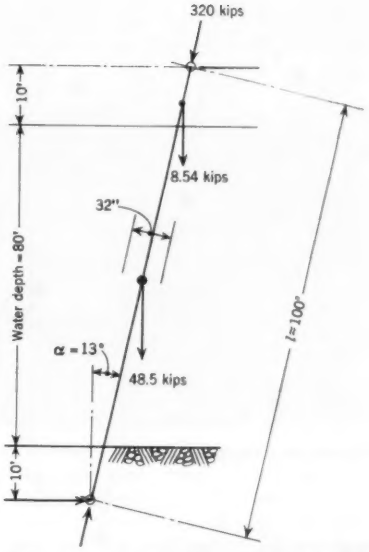


FIG. 5. Driving condition for a 13-deg batter pile is shown where water depth is 80 ft and driving force 320 kips.

47, have been successfully used in lake platform foundations.

Since 1951, Creole has cast over 1,500,000 lin ft of concrete piles. The foundation piles have ranged in size from 16 to 44 in., those over 30 in. being tapered. It is estimated that the piles produced can be represented by one average pile size, tapered from 34 in. square at the base of the point to 24 in. square at the head of the pile, or 29 in. in average section. This pile has a 200-ton capacity for a design length of 100 ft. Application of the long column formula would require an average section of 36 in. for this pile.

It is conservatively estimated that the application of the long column formula would have increased Creole's pile cost at least 25 percent, or about $8,000,000 in the past eight years.

TABLE I. Computations for the example

Deflections, Axis 1-1

$$\delta M_i = \frac{Pe_w l^2}{8EI} = 0.09 \text{ ft}$$

$$\delta_d = \quad = 0.09$$

$$e_h = \frac{100}{750} = 0.13$$

$$e_c = \frac{100}{1{,}000} = 0.10$$

$$\delta = \quad = 0.41 \text{ ft}$$

$$\Delta = \frac{0.41}{1 - \frac{5 \times 320 \times 100^2}{48 \times 4{,}000 \times 144 \times 3.32}} = 0.49 \text{ ft}$$

Moments, Axis 1-1

$M_d = 160$ kip-ft; $M_\Delta = 157$ kip-ft; $M_i = 141$ kip-ft; $M_t = 458$ kip-ft

Deflections, Axis 2-2

$$\delta M_i = \frac{Pe_w l^2}{8EI} = \frac{320 \times 0.33 \times 100^2}{8 \times 4{,}000 \times 144 \times 2.10} = 0.11 \text{ ft}$$

$$\delta_d = \quad = 0.0$$

$$e_h = \quad = 0.13$$

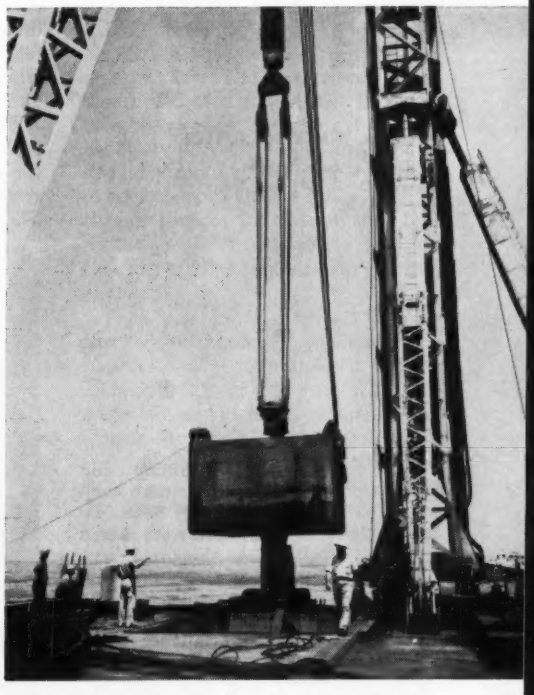
$$e_c = \quad = 0.10$$

$$\delta = \quad = 0.34 \text{ ft}$$

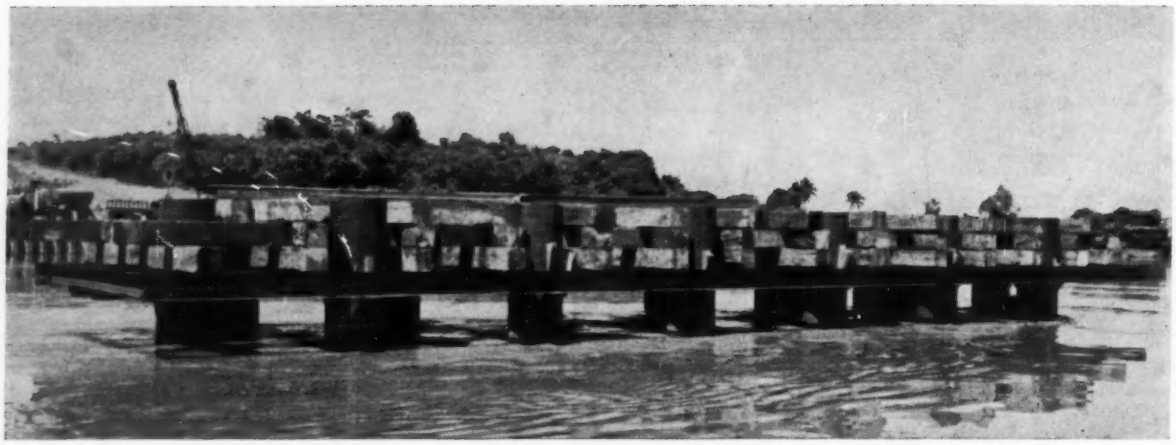
$$\Delta = \frac{0.34}{1 - \frac{5 \times 320 \times 100^2}{48 \times 4{,}000 \times 144 \times 2.10}} = 0.47 \text{ ft}$$

Moments, Axis 2-2

$M_d = 0$ kip-ft; $M_\Delta = 150$ kip-ft; $M_i = 106$ kip-ft; $M_t = 256$ kip-ft



A 200-ton weight is used to force vertical piles down. Batter piles are driven with a 30,000-ft-lb hammer.



Structural-steel template platform was prepared to serve as a drill platform by the addition of 12 X 12-in. timber decking.

Drilled-in caissons for bridges in Southeast Asia

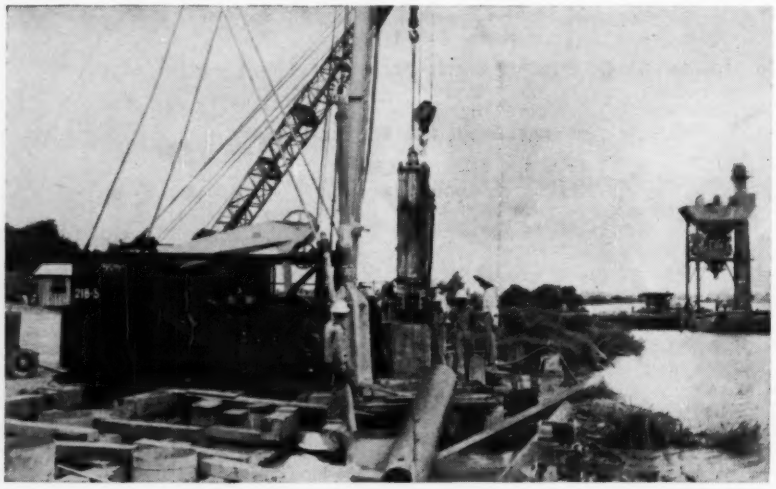
FRANK A. DiMATTEO, F. ASCE

Resident Engineer, Saigon
Johnson, Drake & Piper, Inc.
New York, N. Y.

A joint American-Vietnamese project, aimed at providing a first-class highway between the capital city of Saigon and the resettlement refugee village of Honai, includes the construction of a bridge a half kilometer long (0.3 mile), supported by drilled-in-caisson piling. The bridge, spanning the Dong-Nai River some 20 km (12.5 miles) northeast of Saigon, is probably the first in the world to employ exclusively drilled-in caissons in foundation construction. The project is sponsored by the International Cooperation Administration and is part of a $62 million highway program in the Republic of Vietnam to rehabilitate the highway system by replacing war-damaged and outdated bridges and roads.

Drilled-in caissons for the subsurface pile foundations were selected for expediency and economy in preference to open or pneumatic caissons. The entire Dong-Nai River bottom is underlain at an average depth of 50 ft below mean water level with a blue-gray basalt rock on which the heavy bridge loads are supported. The same material is quarried and processed nearby for use in concrete, base course, and asphaltic concrete. The unstable silty overburden, which varies in depth from 7 ft to 77 ft, was another factor in determining the choice of this type of bedrock support for the pier foundations.

After subsurface explorations were completed in December 1958, the Capitol Engineering Corporation of Dillsburg, Pa., the engineering contractor, proceeded with the bridge design, submitting several alternates to the United States and Vietnamese government agencies. For the foundation, the U. S. Bureau of Public Roads selected drilled-in steel-pipe caissons 30 in. in diameter to support the reinforced concrete piers. These in turn support the bridge superstructure,



After drilling and bailing, the caissons, of 30-in. diameter, were driven into their rock sockets with the double-acting steam hammer. The ram-type bit is shown left of the hammer and the job-fabricated bailing bucket in center foreground.

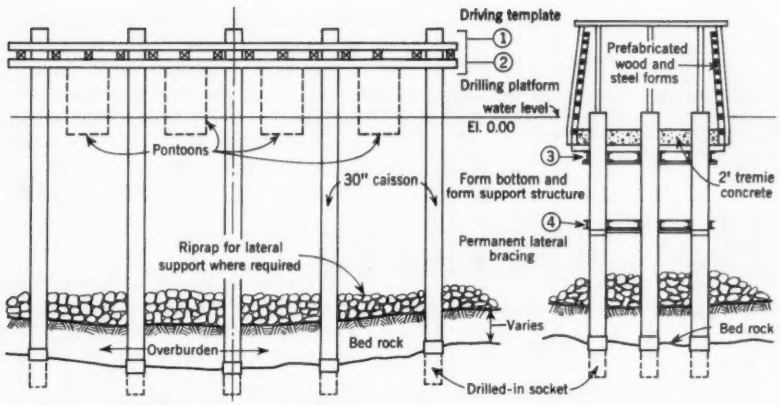


FIG. 1. Multipurpose template platform served four functions, as (1) a driving template, (2) a drilling platform, (3) a form bottom and main support for the pier forms, and (4) permanent lateral bracing.

which consists of 6 continuous plate-girder spans and 2 prestressed precast concrete-beam approach spans. The design criteria used for the entire bridge and highway were based on AASHO's H20-S16-44 loading. The firm of Johnson, Drake & Piper, Inc., of New York and Minneapolis, general contractors, was selected to construct the bridge and connecting highway.

Template platform with four functions

One of the several on-the-job innovations employed in this operation was the design and construction of a multipurpose template platform, as shown in Fig. 1. The structure served four different functions in the course of the work:

1. It was used as a template for properly locating the caissons in the pier cluster. The template, weighing 17 tons, was floated into position on job-fabricated pontoons and anchored to the work barge for stability. When the correct location for the template had been established, the center pile was driven first, followed by 6 others on the periphery of the pier, all the work being done under the supervision and guidance of engineers. The caissons were driven open end to bedrock and subsequently cleaned out by water jetting. The template was then raised to its proper elevation above high water, the pontoons removed, and the platform secured to each pile with clamps and bolts.

2. To utilize the steel template platform for the drill rig, timber decking was placed on it to support the drilling equipment and to provide a suitable and safe work area. Before each caisson was drilled and driven into its socket, the individual securing clamps were loosened. On completion and acceptance of each pile, the fastening devices were again secured. When all 19 caissons had been completely drilled and driven, the equipment was removed and the platform was then ready to serve in the operation of concreting the pile core, which followed.

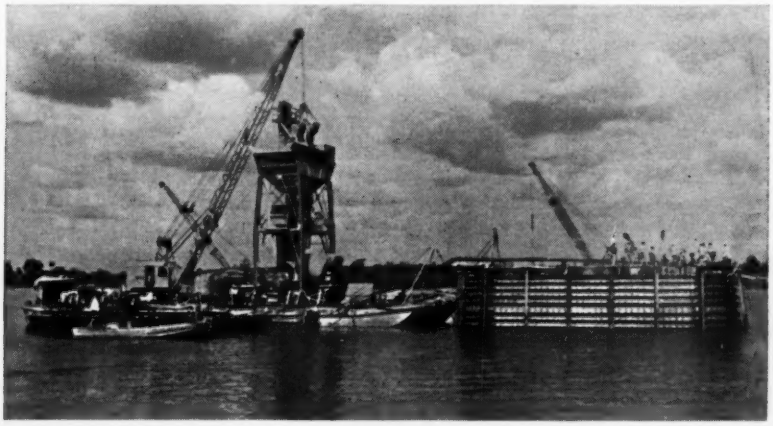
3. The template platform served as the form bottom and main support for the pier forms. Following the concreting of a composite pile in a caisson, the prefabricated form sections were assembled on the template platform. By using 10-ton chain hoists supported on two piles at each end of the pier, the entire load was transferred by releasing the clamping devices. The whole assembly was then lowered into the water to the prescribed elevation and the clamps rebolted.

4. Finally, on completion of the concrete pier work, the template platform was dropped lower, to a point midway between the pier bottom and the river bottom, to serve as a permanent lateral brace. All underwater work was performed by a skilled construction diver.

Drilling was accomplished with three Bucyrus-Erie Model 36-L oil-well spudders working on a two-shift basis for four months. A total of 122 caissons of 30-in. diameter were drilled, secured into their rock sockets, and prepared for the construction of the composite pile structure. A total of over 4,500 cu ft of rock was drilled using a 4,400-lb percussion bit. The churn-drill process pulverized the hard basalt, so that cleaning by bailing bucket, followed by air lifting, resulted in a clean pile, free from foreign matter. The prescribed socket depth of 5 to 6 ft was met in practically all piles except where it became necessary to drill deeper to obtain a firm, dry footing. The greatest drilled-in socket depth was 18 ft. Driving the cutting shoe of the caisson into bedrock was performed with a McKiernan-Terry 9B-3 double-acting steam hammer.

Each pile and boring was visually checked by the design engineers. The inspectors, who were lowered into the 30-in. piles, were equipped with adequate illumination to examine the footing for depth, for proper anchorage, and for freedom from infiltration by water and silt. The piers closest to the river bank were riprapped to increase the stability of the piles against strong tides and negligible support from overburden.

Following the drilling, driving, and cleaning operations, the 30-in. caissons were cut off to the prescribed elevation. Sufficient tremie seal grout (4,000 psi) was then placed in the socket up to the lower end of the driving shoe, and the 14-in. BP 102



The floating batch plant and pumpcrete unit produced an average of 50 cu yd of 3,000-psi concrete per hour.

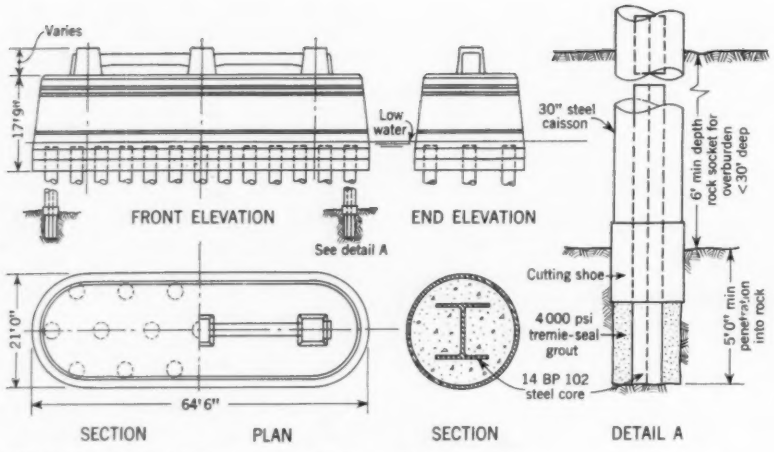


FIG. 2. Main pier details are seen in plan and cross section.

core-beam reinforcing was dropped into position. After 24 hours, the caissons were pumped out, cleaned again and made ready for placing of the 3,000-psi concrete that encases the core beam and forms the pile-column structure. The socket and core reinforcement are shown in Fig. 2.

After the prefabricated pier forms were assembled and lowered into the water, a 2-ft seal of tremie concrete was poured to insure watertightness against the hydraulic pressure created by a 10-ft tidal action. This permitted a dry operation for the placing of over 20 tons of reinforcing steel and for the pouring of 750 cu yd of concrete.

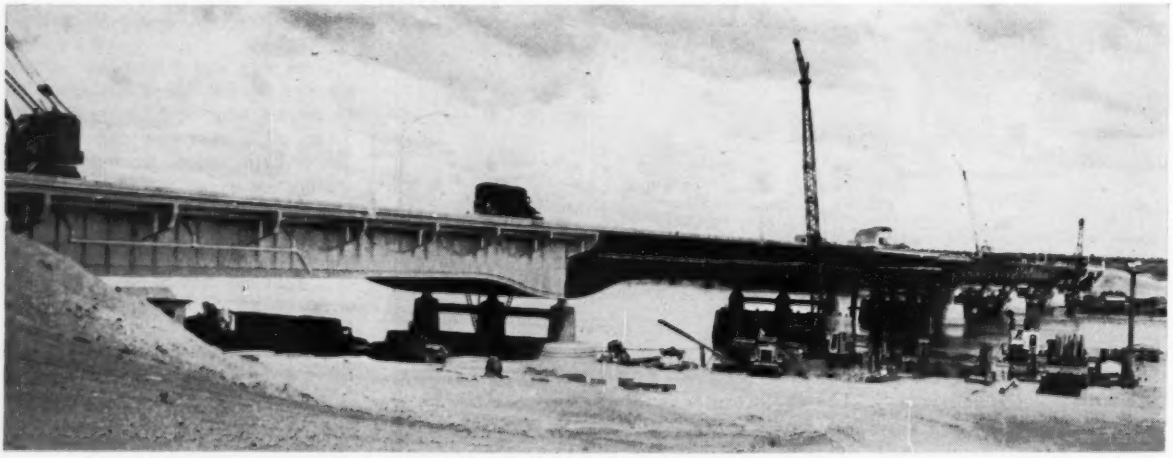
Wood and steel forms used

The lumber and steel forms were built at a nearby shop, transported to the bridge site, and assembled there. Both local and imported lumber was used in all form work and temporary construction. An interesting sidelight on the locally produced lumber is that early in the project the construction contractor experienced difficulty in its use. Although lumber in Vietnam is abundant, of good quality, and structurally sound, seasoned lumber is scarce. Because of the excessive shrinkage and warpage of improperly dried lumber, the contractor used locally produced lumber on the project sparingly and only in secondary members where its uncontrolled behavior affected neither strength nor appearance.

Using available government surplus equipment, the construction contractor assembled a pumpcrete floating batch plant for use on major bridge pier construction. The complete unit, consisting of a dry batching plant, a transit mixer (removed from its mobile tractor), and a concrete pump unit, produced an average of 50 cu yd of concrete per hour. Sand and gravel were transported to the site by trucks, then off-loaded onto barges, which were towed and secured to the batch plant. The plant was then fed with a ½-cu yd clamshell bucket operating from the plant barge.

With the exception of a few hours spent during the initial operation in adjusting the various mechanical and electrical units, the entire installation operated continuously without down time during the production cycle for the four main water piers. This is especially noteworthy since all the mechanical equipment was operated by indigenous personnel trained on the job. This assembly made possible the continuous pour required by the specifications, and it eliminated costly overtime and night operations. Details of the concrete piers and caissons are shown in Fig. 2. The bridge was opened to traffic in February 1961.

This program in Southeast Asia, one of the many sponsored by the United States Government throughout the world, is aimed at developing the basic structure necessary to work toward economic independence in newly developing nations. As an important facet of the highway program in Vietnam, both the engineering and construction contractors conducted on-the-job training for all crafts, engineers, and supervisory personnel. The introduction of new equipment and modern construction and engineering methods, such as the Drilled-in caisson, is another step forward in America's drive to help its friends to help themselves.



Dong-Nai River Bridge, here seen nearing completion, has two 80-ft prestressed concrete spans and six continuous steel-plate-girder spans. The superstructure contains 3,200 tons of structural steel and 1,000 tons of precast beams.

Lessons learned from HURRICANE DONNA

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Damage done by hurricane Donna is still being studied by engineers and public officials throughout the state of Florida. Studies completed or still in progress should make it possible to avoid a recurrence of the considerable damage that occurred when Donna hit Florida on September 10 and 11, 1960.

Donna was the first hurricane to hit the coast of Florida since October 1950. The storm reached the Florida Straits north of Cuba on September 9 and curved northerly and northeasterly through the Florida Keys and across the mainland of Florida along a line extending roughly from south of Naples to south of Daytona Beach. The storm then continued in a northeasterly direction across the Atlantic. It touched the mainland at North Carolina and again in Connecticut and dissipated itself across northern Canada. Observations in this article are confined to Florida.

Wind velocities during the storm at points throughout the state, as reported by the Weather Bureau, are given in Table I.

Damage by wind and water

Structural damage caused by Donna can be broken down into water damage and wind damage, or a combination of both. Water damage (including tidal effects) was most evident in low-lying and exposed areas of the Florida Keys and in the area on the west coast of Florida at Bonita Springs Beach. Road approaches to some of the bridge structures on the Overseas Highway to Key West were washed out. At one point near Tea Table Key, a section of fixed bridge was battered out by the action of a barge alongside. The pipeline carrying water to the Keys and Key West was broken in several places.

Total damage caused by Donna in the state was estimated at over 350 million dollars. There were 13 deaths directly or indirectly attributable to it.

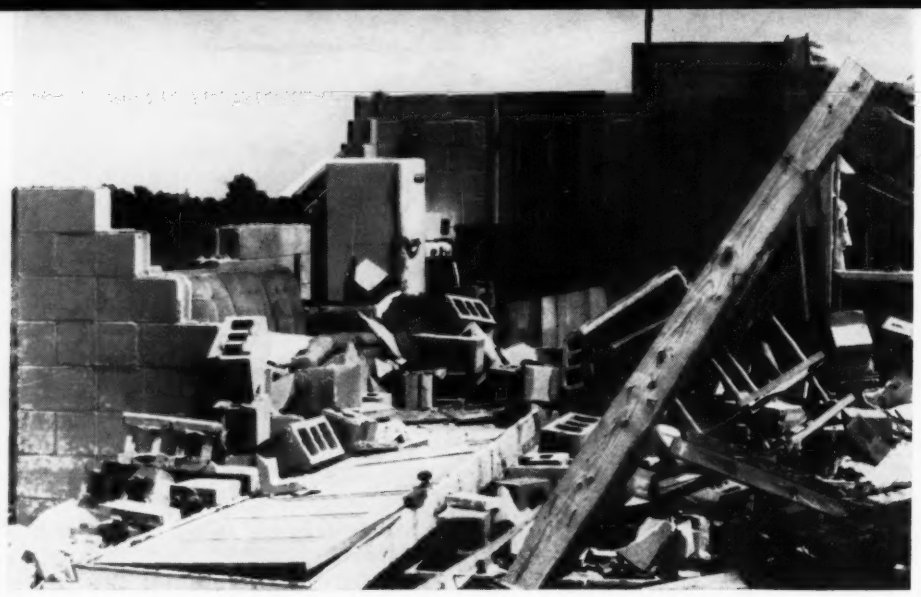
Buildings constructed at low elevations along the Keys, in areas where high tides occurred, suffered the severest damage. It may be noted here that properly designed structures, where due consideration had been given to design against wind and wave action, withstood the storm with hardly any damage whatever.

Water damage occurred where buildings were built on spread footings in exposed locations without taking into account possible scour underneath the footings. Wave action also exerted a damaging force on buildings built at grade close to the water. Tides rising to at least 12 ft above mean low water in the Keys area caused foundation failures where buildings were built on spread footings. Similarly located buildings, properly founded on piling, or keyed into the underlying Keys coralline limestone rock, suffered no damage at all.

Structural damage observed was mainly confined to one- or two-story residential or motel-type construction. Properly designed industrial-type buildings such as the pumping plants of the Florida Keys Aqueduct Commission withstood the storm with hardly any damage, even though these buildings were in extremely exposed locations. Radio towers in general

TABLE I. Wind velocities during hurricane Donna in Florida

Location	Fastest Single Mile Wind Velocity, mph	Gust Velocities mph
Sombrero Key Light Ship	118	150
Marathon Shores in Florida Keys	120+	...
Tavernier in Florida Keys	120+ (needle solid against anemometer pin for 45 min)	...
Miami	64	80
Everglades	150 est.	Gusts est. at 165-175
Fort Myers	92	121 Weather Bur. 155 Gusts reported from private anemometers
Lakeland	68	90 est.
Daytona Beach	..	99



Demolished residence between Fort Myers and Bonita Springs about 5 miles from beach area shows results of high winds. A U-block tie-beam had been placed in the top of the wall below the roof but no anchorage was provided between the tie-beam and the walls and foundations.

withstood the storm satisfactorily. The writer knows of only one tower that was damaged in the Keys area, where the full force of the storm was felt.

Wind damage seemed to have been the kind sustained by roofs, roofing materials, anchorage details and tie-downs. Observations on flat roofs especially indicated high uplift pressures exerted by high-velocity winds, probably equivalent to 3 or 4 times the velocity pressure of the wind at the leading edge of the roof. Lessons learned in Miami after the October 1950 hurricane were apparently not heeded in many parts of the state. (See "Miami Suffers Slight Structural Damage in Severe 1950 Hurricane," E. A. Anderson and H. S. Saffir, CIVIL ENGINEERING, Dec. 1950, vol. p. 744.)

Edge attachment of roof coverings was a weak point where roofing failures were observed. Drip-strip and gravel-stop failures at the edge of roofs contributed to roofing failures.

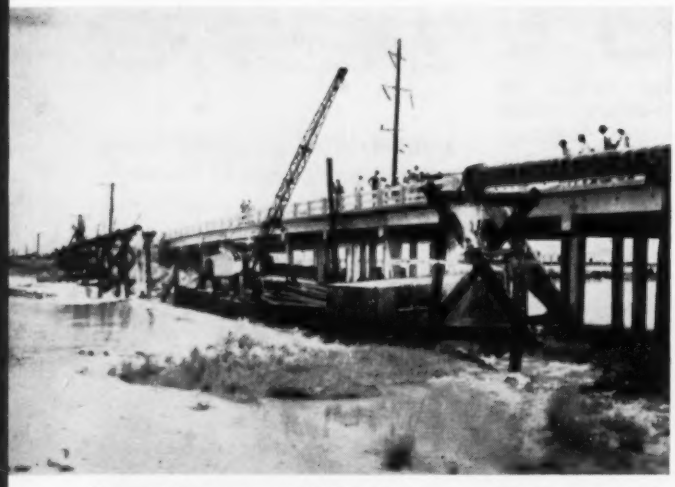
Roof rafter failures were in general due to failure of the anchorages in uplift. Failures of roof rafters or trussed rafters were not in evidence. Most failures were at anchorage or connection details.

The storm demonstrated that high-velocity winds will seek out the weakest part of a structure. Careful attention must be given to details of design and construction such as rafter anchorages, drip-strip fastenings, roofing fastenings, etc. Most of the observed failures occurred in these details.

Where roofs blew off, wall damage generally occurred. Lack of the bracing effect and diaphragm action of the roof in some cases caused a failure of supporting walls after the loss of the roof.

Failures were observed in stud bearing-wall construction where roof rafters were anchored to the top of a double plate, where no anchorage was provided between the plates. Lack of attachment of sill to foundation was also noted. In general, it may be stated that anchorage requirements for construction in areas exposed to high-velocity winds must be carried down directly to the supporting foundation.

Breakage of windows or doors was



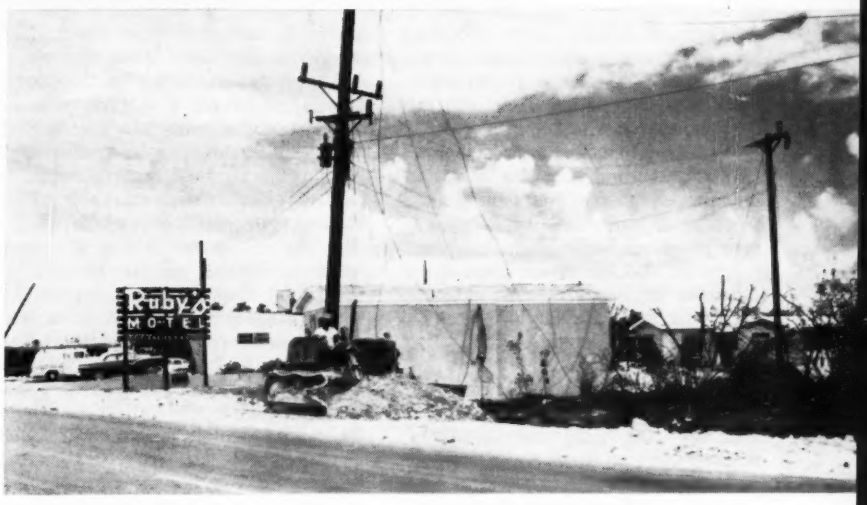
Donna ripped up over 5,000 ft of this 18-in. pipeline in several places, thus destroying the only source of fresh water for the Keys. Here at the Vaca Key Bridge extremely high tides swept a loaded barge into the line, destroying the supporting trestles and damaging three pile bents. The line was operating again within 48 hours. This photo and that at right, courtesy of Allis-Chalmers Manufacturing Co.

A bailey bridge airlifted from Fort Campbell, Ky., and put in place by Army engineers three days after the storm, spans gap of about 40 ft in the Tea Table relief bridge that was knocked out by a runaway barge. At left, a barge-mounted crane retrieves one of the concrete-reinforced piles that was knocked out. A new bridge was scheduled to be completed within 30 days.

Basic structure of a motel at Flamingo remained in good condition but damaged windows and doors permitted destruction of the interior by water and wind.

An Allis-Chalmers HD-6 dozer grades and compacts coral-lime rock fill, dumped along the Overseas Highway in Marathon, where rushing water washed out shoulders up to a depth of 3 ft. Photo courtesy of Allis-Chalmers Manufacturing Co.

common and was the primary cause of considerable damage to residences and motels. Windows can be adequately protected with properly designed hurricane shutters. However, in the absence of shutters, damage can be considerable; gutting of the interior of many residences was evident where water had entered the building after exposed unshuttered glass windows failed. Failure of windows also increased uplift on roofs by introducing a positive upward pressure in the interior of a building acting on the roof in addition to the suction pressures acting above—in the case of flat or low pitched roofs. Parts of window assemblies, such as mullions, jambs, etc., should be designed for the applicable wind loads.



To prevent hurricane damage –

••All structures in areas subject to hurricanes should be designed by engineers and architects with special experience in this type of design. Supervision and inspection of construction by the designer is also of the utmost importance, especially in areas where there are no building departments.

•• Consideration should be given in the design to a careful study of the effect of high-velocity winds on the structure. Care should be taken in the design and detailing of all parts of the structure.

•• The height of the structure, its geographical location and its location with respect to exposed bodies of water should be carefully considered in establishing the design wind loads.

•• Design wind loads should be predicated on the basic design formula:

$$P_w = C_s \times C_h \times 0.00256 \times V^2$$

where C_s is a coefficient based on shape, $C_h = (H_h/H_w)^{1/7}$, and V^2 is taken at 30 ft. Design loads may be picked from the current 1955 American Standard Building Code Requirements for Minimum Design Loads in Buildings and other structures—in the absence of local building code requirements or in the absence of special studies. Unusually shaped buildings and buildings with long overhangs should be carefully studied to determine possible action by wind forces.

•• Large window areas should be provided with shutters properly designed to resist hurricane wind loads.

•• Proper design is imperative for lightweight structures, where the effects of gusts are of more importance than in the case of concrete structures, where the ratio of dead load to live load is greater.

•• Higher design loads should be used for unusually exposed structures.

•• In choosing probable periods of recurrence of high-velocity winds, the importance of the structure should be considered.

•• Structures built on the ocean front should be on piling and the floor grade should be high enough above the adjacent ground to prevent water damage.

In the preparation of this article the writer is indebted to the report of a committee (of which he was a member) headed by Merrill E. Crissey, Construction Control Supervisor of the Dade County Building Department. Other sources to which he is indebted are the committee report of John Stetson, architect, and the Report on Hurricane Donna of Gordon Dunn, Chief District Meteorologist, U.S. Weather Bureau. Photos not otherwise credited were taken by Paul Murray of the Society of Aluminum Engineers.

The engineer's obligation to disclose all the facts

ADOLPH J. ACKERMAN, F. ASCE, Consulting Engineer, Madison, Wis.

The greatest tribute to the founding fathers of our country came to me directly from the heart of an immigrant who had studied American history while he was working for the day when he could come to this land of freedom. He had acquired an inspiring appreciation of our noble heritage; by contrast, most of us tend to take it for granted.

We are also the beneficiaries of another noble heritage—our engineering profession—and we have accepted the obligation of serving as the custodians of its traditions. But here again, I regret to say, we tend to take things for granted and to forget the history and high standards which our predecessors have set for us.

As an introduction, therefore, I am going to be frank enough to admit that some of us in this generation haven't been doing so well. What I have to say will be largely directed to students, the next generation of civil engineers. I would hope that this will help them to acquire some appreciation of the problems of the coming generation of civil engineers, as well as of the obligation of an independent consulting engineer when he is called upon to review a new engineering program which involves tremendous future commitments on behalf of the public.

The miracle of our water supply

Looking back on the achievements of our engineering profession, I think that one of the greatest is the miracle of our water supply throughout the country. You don't appreciate it—in fact, you just never think of it—until you've lived outside this country, particularly in most parts of South America, where one is constantly warned to "boil your water before you drink it." Then you come back here and you go to any faucet, you put a glass under it, and you draw some water and drink it without question.

If you stop to think of it, this represents, first of all, a marvelous tradition of engineering practice in the design of water supply systems and in the operation of those systems. It also typifies the remarkably high standard of engineering which we enjoy in this country as part of a natural tradition, as well as the sense of individual responsibility displayed by every engineer in charge of a municipal water supply system. It also represents, to a very large degree, a stamp of public approval and confidence in our profession; and I would say we have every right to claim that confidence for our civil engineering profession. This typifies the rich heritage of our profession in terms of past performance.

Professional standards

Consider now what would happen if a city's water supply engineer were ordered by some dishonest official to contaminate the water and to do it in such a way that it could not be detected until, perhaps in five years, it would be found that the people were all suffering a permanently harmful effect. We would immediately say, "Why, that's impossible!" And yet, in effect, the equivalent of such exploitation of professional disciplines and public confidence is occurring today in new areas of technology and engineering.

I recently posed a similar question about introducing a harmful principle, or a harmful policy, with respect to some of our current new developments in engineering, and I was promptly told by my civil engineering colleagues, "Oh, that couldn't happen! The profession would rise up in arms! The American Society of Civil Engineers wouldn't stand for that!" Then I proceeded to explain that it has happened and it is happening, and nobody is doing much about it; and I outlined the incident. The net result was a realization that, in terms of today's technology and new problems, we are not perpetuating our profession's heritage and disciplines.

Individual responsibility

The foundation of engineering is individual responsibility and professional integrity. This must have its beginning in the classroom, where our profession gets its start. I can testify to the influence from the classroom, particularly in having been fortunate enough to be a student of the late Daniel W. Mead, Past President and Hon. M. ASCE. He has had a great influence on many engineers. Those of us who were in his classes will never forget his repeated references to any unjustified project—"It's economically unsound!" And he constantly urged us to consider whether any proposal advanced by ambitious public officials, or by eager civic groups, really had validity.

Just recently a new book came out, *The Story of Engineering*, by James K. Finch, F. ASCE. It is a valuable book. There is a quotation in it from Gen. John J. Carty, one of our old-time engineers who had a policy of asking three questions whenever a new proposal was brought to him: "1. Why do this at all? 2. Why do it now? 3. Why do it this way?" That's quite a good rule to follow in almost every new venture when it first appears. I think you will find that a great many proposals for new projects could be eliminated just because of the inability to produce satisfactory answers to those three simple questions.

Our professional heritage

The engineering profession, and particularly the civil engineering profession, has a great heritage. This

heritage is based on the same principles on which our nation was founded. We therefore have a great obligation to defend this heritage and, at the same time to protect the public welfare.

I was fortunate recently in finding a statement by Rear Admiral H. G. Rickover, who has summarized what our obligations are with such clarity that I can do no better than to quote him. He said:

"Since engineering is a profession which affects the material basis of everyone's life, there is almost always an unconsulted third party involved in any contract between the engineer and those who employ him, and that is the country, the people as a whole. Those, too, are the engineer's clients, albeit involuntarily. Engineering ethics ought, therefore, to safeguard those interests most carefully. Knowing more than the public about the effects his work will have, the engineer ought to consider himself an officer of the court and keep the general interest always in mind.

"Service ceases to be professional if it has in any way been dictated by the client or employer. Professional independence is not a special privilege but rather an inner necessity for the true professional man and a safeguard for his employers and the general public. Without it he negates everything that makes him a professional person and becomes at best a routine technician or a hired hand, at worst, a hack."

Crisis in engineering

This statement is particularly timely because I believe that today engineering is in a major crisis. I could mention simply the fact that we hardly ever hear of a serious disciplinary measure with respect to professional conduct. There may be some minor ones, but I don't know whether you hear of any such incidents; they are not mentioned in our professional publications, and yet, in many places there is common talk of important infractions. It is disappointing to find our profession unable to come to grips with important issues involving violations of the code of ethics.

Let me interpose here briefly, speaking to the students, that our professional Society is only what you yourselves, and all of us individually, will make of it. A Board of Directors is not an all-powerful body with every bit of wisdom concentrated at that level. Society accomplishments must depend on committee efforts, on local efforts of all types and on individual member effort. In the final analysis if we, at the local level, fail to preserve and protect and advance our professional obligations and disciplines, we can hardly expect them to be fully preserved and upheld by some remote directional body. I'll go a step father in digressing for a minute, to urge you all to get into committee work. As an example, the work of the Task Committee on Professional Education, in which I had the privilege of participating, was a most valuable experience in giving me a new perspective on professional problems and responsibilities. And here again, it was what was done at the individual membership level that added to the sum total of our professional resources.

Decline of the profession

I firmly believe that the civil engineering profession stands at the forefront of all the other branches of the profession. This was clearly brought out in our Task Committee report in these words:

"Professional engineers have given an oath to serve the public interest above all others. Civil engineers are generally to be found in the forefront of the negotiations involved in clearing the many hurdles such as clash of interest between elements of local, state and Federal Government, problems of financial feasibility, and general impact of the proposed project on the community. The harmonizing of all the conflicting interests involved in any great civil engineering project requires a broad understanding of the political, legal, business, and human elements inherent in the situation. Of equal scope and importance are the engineering sciences required in carrying out the final design." As you young men enter the profession, I'm afraid you're going to find that there has been a substantial deterioration in this concept of our profession. There are not many engineers today holding positions where they resolve this complex group of responsibilities. In fact these duties have largely been taken over by the politicians, and by the heads of departments of government. It is considered rather generally today that the engineers are the ones to do the design work. I must say that I have seen some tragic deterioration in our profession in that respect. This situation may be summarized in another way as an exploitation of the profession to gain political power.

At the Museum of Science and Industry in Chicago you will find inscribed over the entrance:

"Without engineering, freedom could bring you a happier but not an easier life. Without freedom dictators could use engineering to enslave you."

This implies that, unless we are vigilant, politically powerful leaders could exploit our professional disciplines for their own purposes and could also exploit the public's faith in our profession. Today such exploitation can readily emerge as a result of a general apathy within our profession, and from our failure to defend our professional responsibilities against political encroachments.

Decline in education

Finally, we must also confess to a general failure in preparing the next generation of engineers for the problems ahead. This is not just a responsibility of the educators. It is first of all, I would say, the responsibility of the practicing engineers, because if we call ourselves a profession, and practitioners of an art, then there must be, by definition, a master-apprentice relationship, and every practicing engineer owes the transfer of some of the arts that he has acquired to the next generation. The educators are, of course, the intermediaries, and they have the major responsibility in communicating the traditions and responsibilities and obligations of our profession to the next generation. We are guilty, however, of sadly neglecting our educational system, our faculties and the problems of modern curricula at all levels.

You students are now fulfilling the present curriculum requirements towards getting a degree, and you may feel that you have met the first conditions for entry into the profession. But let me say this: In these days of technological complexities, and legal complexities, and administrative and political complexities, all of which would eventually become part of your assignments in future engineering ventures, it is up to you—and it is within your means and resources—to "engineer" your own education to whatever level you wish, by choosing whatever additional training you recognize as essential. And it is within your means to "engineer" your own career to a considerable degree. All of this is really a prerequisite to the development of a personal characteristic, the characteristic of independence, without which you cannot be a successful professional engineer.

Engineers in the cold war

Now, coming somewhat closer to the problems of today: I was interested in hearing one of our engineering leaders at the recent Boston Convention point out that engineers are really in the front line of the cold war. That doesn't mean merely in terms of de-

signing and developing new military facilities of all types. The real cold war is not a military war, it is an ideological war. And the problem is the defense of our way of life and our form of government and our heritage, our national heritage.

If you want to gain a quick understanding of "the front line," and of the basic issue in today's world, I can refer you to the first chapter of Whitaker Chambers' book, *Witness*, which contains a letter to his children. I have read it six or seven times, and I am getting to understand it more and more. I know of no better way to acquire some understanding of what it means to be engaged in an ideological struggle which is basically technological. It will help to clarify for you what the real issue is in the present worldwide struggle. And you can't be good engineers unless you understand that issue.

The great issue today is, essentially, the clashing of two great forces, the force of fear and the force of faith, and this includes the application of technology and engineering, either under the force of fear, or under the ethics of a free society.

Reeducation of our profession

A keen observer of the current technological revolution recently remarked "It is sort of grim watching a free nation commit suicide." That comes from a very competent person. It summarizes rather briefly what is happening to us, rather than what is being done to us; and it behooves us to look at ourselves. The reeducation of our profession in terms of our present day and future responsibilities is long overdue.

We have failed, for example, to recognize the importance of maintaining contact and communication with the public. We go our way, we do our job, but we do very little to interpret to the public what we are doing. And if the public doesn't know, how can we gain the confidence of the public when it comes to a critical issue? We need to emphasize that we are here to protect the public interest —we need to state the facts on new proposals, and to oppose harmful proposals. The public is forgetting us and who we are. People are attracted, instead, by the image of the new scientists.

There are a number of false standards developing, particularly within our profession. We have a false standard of withholding unpleasant facts about performance within our profession. There seems to be a sort of unwritten code to withhold disclosure of an unpalatable opinion, or just to remain silent. If you could understand the significance of that, you would appreciate how much harmful activity is being condoned just by our failure to speak up. Every time we fail in that respect we are giving aid and comfort to the enemy. To do the right thing demands individual responsibility and initiative, and the necessity of declaring oneself at critical times.

I was greatly impressed last April by a voice which came out of Cuba, where the problem of individual responsibility was dramatically described by a Cuban editor during the height of the Cuban crisis. He was being commended (in absentia) by the Inter-American Press Association for his fight for press freedom. He told his readers that he "will continue his work in Cuba as long as God permits." He expressed regret that "it sometimes appears that I fight alone, that I'm not accompanied in this battle by those who should join me. Within four walls there are many who support this fight, but in public they guard a timid silence. I must admit sorrow at the sight of certain men and certain institutions who adopt the methods of a chameleon, masking themselves at times green or red or whatever color they consider most protective. I am sad and sometimes ashamed of the sight of these gentlemen, apathetic, faint-hearted, submissive." And he concluded, "but I have today more than ever the sensation that a great force of opinion supports this newspaper, a force which may open the way to definite triumph for those standards which are inherent in a Christian democratic society such as ours."

Obligation to disclose facts

We have a declaration of "Faith of the Engineer" which states: "Jealous of the high repute of my calling, I will strive to protect the interest and the good name of any engineer that I know to be deserving, but I will not shrink, should duty dictate, from disclosing the truth regarding anyone that by unscrupulous acts has shown himself unworthy of the profession."

Incidentally, when, in many years past, have we witnessed a member of our profession fulfilling this latter obligation? It is an obligation which an auditor in the financial field considers as a matter of routine. He is called upon to audit books, and he is automatically expected to disclose any shortcomings or failures. Out of those failures come corrective measures. When we stop to apply this to ourselves, we must realize that some of our most important professional knowledge has grown out of failures. We learn from failures. And just as we have failures in bridges or in other structures, we have failures also in administration, and in personal discipline, and in professional performance. And so it behooves us to be respectful of failures and at the same time to be clear and honest about them.

Sound versus unsound planning

There are two types of long-range planning for water supply. There is the general forecasting or visualization of what may develop in the future; engineers, of course, have the skill to do that better than almost anyone else. But it is quite another matter to formulate a plan with a firm commitment for a great length of time, up to 40 years or more, and to ask the public to underwrite that commitment. As a matter of fact, it should not be underwritten. A commitment should not be made beyond what can clearly be substantiated by competent members of our engineering profession, and of the legal profession, and of the financing profession. A firm commitment should be of limited size. If this wins public approval, a project can be built and a well-defined goal can be attained. If by that time the economic situation has changed from what was originally visualized, the next incremental step can be postponed or it can be accelerated. But the new decisions and the new choices can be made by the next generation, and by the next group of public officials at that time.

The mere fact that disregard of this important principle is so easily introduced is probably not recognized by most engineers. Ordinarily we don't think about it unless we are suddenly confronted with an idea that here is something proposed extending, say, to the year 2020. We find general plans being formulated in terms of meeting a population growth which cannot be confirmed. Future water demands are estimated on a per capita basis and this appears to call for a vast amount of water to be developed. Finally, cost estimates are put together, and this results in a figure something like $10 billion, or $10,000 million. Such a figure, of course, is beyond comprehension. Even a so-called first step which is finally chosen, such as a $1,750 million plan financed by issuing bonds, is beyond the comprehension of voters and taxpayers. The question of how this is to be administered is hardly given a thought. The propaganda in support of the "new era of greatness for the State" gets under way. The magnitude of this thing begins to capture the imagination of

people. The project is finally regarded as something "within the means of the State," without any satisfactory evidence of financial soundness. Finally, election day arrives when the people must make a simple choice of "yes" or "no" on a terribly important question.

Dangers of false planning

The dangers of this new type of planning (which we engineers are generally guilty of accepting without careful study) were clearly described in 1951 in a book by Geoffrey Dobbs on *Planning the Earth*. He analyzed this present-day type of "global planning" as a new political movement and identified it as,

". . . the manipulation of natural resources in the interests of centralized power. Planning implies control, and control over water is an end admirably served by the building of hydraulic projects. The spread of controls from water to almost everything else makes an instructive study of the totalitarian nature of planning. The emphasis on the control of water in totalitarian planning is not new. The first centralized state arose on the banks of the Nile on the basis of water control, and it is symbolized today by the vast slave-built tombs of its rulers. As history has repeatedly shown, the ultimate evil of centralized planning is that it is the stealing of choices. The government committee or the experts, by systematically depriving people of the opportunity of making their own choices, trespass on freedom's domain step by step."

Now it is in this situation that the engineer must choose whether he will join in the introduction of a new political movement, or whether he will resist it and instead insist upon the preservation of sound professional disciplines.

This general subject of water resources control at the political level has been brilliantly described in a recent book, *Oriental Despotism, a Comparative Study of Total Power,* by Dr. Karl Wittfogel. He has demonstrated that the history of civilization can be examined in terms of two major classes, hydraulic societies and non-hydraulic societies. Culture has had its greatest advance where there has been as abundance of rainfall. Despotism has had its greatest advance where there was a deficiency of rainfall and where there was a need for developing irrigation by governments. From such beginnings the political control of water developed to a point where everybody was subordinate to those who had the power to turn off the water.

A silent revolution

The application of political initiative, and the manipulation and exploitation of professional responsibilities, particularly in the planning of major river developments, is part of a revolutionary transition in government. It was clearly identified for us thirty years ago. In 1929 a book was published by the late Chief Justice of England, Lord Hewart of Bury, in which he identified the step-by-step procedures under which a new form of government can be introduced through the exploitation of professional disciplines in engineering and in law. This book has the title, *The New Despotism.*

I found this book only a few months ago. I knew that the process was going on, but I never knew that it was all spelled out for us. Most of us are too busy to look for such information. This book contains a clear exposition of the steps by which an autocratic political leadership can exploit professional disciplines to gain political power. The past thirty years bear witness to the results achieved in many areas.

In closing I urge you, particularly you young men, to strengthen not only your technical resources but also your professional stature and your personal characteristics, so that you will have no hesitancy in standing up to these issues by which our freedom eventually could be destroyed.

The responsibility is ours

Our profession has been entrusted with the profound responsibilities of creating new engineering projects, and the influence of our works will become part of the history of future generations. Those of us who work on the planning of such projects are in a position where we can see ahead one or more decades, and where we can direct the influences of our work to the right, or allow them, by default, to be directed to the left. If we allow political pressure or fear to motivate us at the planning level, it will eventually overpower us at all levels.

(This article is based on the address delivered by Mr. Ackerman at the General Meeting of the ASCE Wisconsin Section, October 27, 1960, in Madison, Wis., and designated by the Section as "The Outstanding Paper of 1960.")

THE READERS WRITE

Fire damage to a one-story department store

TO THE EDITOR: The article, "Prestressed Concrete Resists Fire Damage," in the December 1960 issue, p. 36, is commendable for making available the facts underlying restoration of a severely damaged one-story department store building located in Horsham, Pa. It tends to shed some light on the fire resistance of a material about which very little authoritative data are available to the engineering profession.

Several conclusions as presented in the article warrant further consideration. Conclusion No. 11, inferring that the prestressed concrete sections as used in this building could adequately receive a fire retardant rating of two to three hours is a questionable speculation. It could well be misleading to those uninformed in fire resistance technology.

If there is a desire for establishing a fire resistance rating, one that is acceptable to all code writing authorities, it may be readily obtained by subjecting the material to the fire test prescribed by the nationally recognized standard ASTM-E119.

For readers not familiar with this common standard, it may be explained that a test sample of about 200 sq ft is uniformly exposed on one side to controlled temperatures. In thirty minutes from start of test the temperature at a control point 12 in. from the face of the sample reaches 1,550 deg F, thereafter gradually increasing to 1,700 deg F at one hour, 1,850 deg F at two hours, and 1,925 deg F at three hours. Obviously no valid comparison, short of speculation, is possible between such a scientifically controlled elevated temperature exposure and the multitude of variables encountered in an actual fire, particularly one that sweeps through an area of 150,000 sq ft. As to be expected, a point readily admitted in the article, is the fact that "The severity and exact duration of the fire . . . are not known."

Therefore, in absence of standard ratings for this material, it becomes equally valid to arrive at other conclusions. There is reason to believe failures may have occurred at surprisingly low degrees of fire severity. For example, the accom-

panying photograph shows collapsed and sagging T's in the women's apparel department. Note that the typical metal clothing racks are still standing, although the clothing was completely burned out. As a guess, the weight of combustibles per square foot is rather low, most likely under 5 psf of the entire floor area. Furthermore, as to duration, loose clothing on racks would be rapidly consumed. This points to a potential severity of not over thirty minutes on the standard time-temperature relationship yet the structure located some 10 ft overhead failed.

This conclusion is further supported by similar observation of the shoe department where failure also occurred. Very likely the fire load was slightly greater in the grocery section where cereals and the like will readily burn but, on the other hand, the large quantities of canned goods did not contribute fuel to the conflagration.

These observations are not idle conjecture. The problem can be approached, somewhat academically, by adhering to the fundamental principles of designing structures for fire resistance, the basis underlying building code requirements. According to BMS-92 (National Bureau of Standards) and other reported surveys of large department stores, the expected fire hazard of combustible content will average well under 10 psf of floor area. It has been long established by the Bureau and widely accepted that 10 to 12 lb of combustibles is needed to develop a fire of one-hour intensity, i.e., one-hour rated construction would provide ample safety.

From the viewpoint of imminent collapse, the end temperature of 750 deg F given in the article for the prestressing strand may be compared to 1200 deg F, the maximum permissible steel temperature at any one measuring point in the standard fire test of conventional steel construction as prescribed by ASTM-E119. For this reason the protection of prestressing steel strands and wires commonly used, applicable to both prestressed concrete and prestressed structural steel constructions, requires a greater amount or more efficient insulation than has been the practice for conventional reinforcing steel or structural steel. Insufficient or inadequate protection could account for premature collapse at lower fire intensities than ordinarily expected.

Experience gained over many years renders assurance that a structure of conventional materials, fire protected for a prescribed rating as indicated, would have withstood, without structural damage, the conflagration described in this article. Obviously, in this case and in the absence of specific information in the article, there was no building code requirement for predetermined fire resistance.

HENRY J. STETINA
Senior Regional Engineer
American Institute of Steel Construction, Inc.
Philadelphia, Pa.

Divergent viewpoints of employer and employee

TO THE EDITOR: Promotion of the public welfare, professionalism, and the like sound fine and are important, but most of us have been in contact with reality long enough to look behind the "façade" and inspect the "structural frame." When this is done in a truthful and unbiased manner I feel that the difficulties the ASCE is having in being truly representative of the *entire* civil engineering profession will be evident.

Any organization that attempts to represent at the same time two viewpoints as divergent as those of employers and employees will tend to be less effective than one with an overwhelming representation of one or the other—such as the American Medical Association.

Obviously a letter will not suffice for a discussion of all the facets of this problem but a few questions may stimulate thinking:

1. Are the immediate goals of an employee the same as those of the employer?
2. What is fair compensation for a professional man and what responsibility does the employer have to see that fair compensation is paid? It may be pointed out that the ASCE, through CIVIL ENGINEERING, assists employers in obtaining professional civil engineering services, and in some cases I would not classify the compensation as fair.
3. Should the ASCE take a stand on what constitutes fair compensation?
4. Should the ASCE follow the lead of the medical profession and classify its administrators separately from its technical men? (I understand that the compensation the administrators receive is considerably less than that of medical doctors.)

College graduates cannot fail to be aware of the differences in compensation received by highly trained technical men —who spend much of their own time studying, taking night courses, obtaining registration—and salesmen, administrators and promoters.

I would be interested to exchange viewpoints on these matters with other members.

KENNETH L. HASSEBROCK, M. ASCE
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Corps of Engineers
Sacramento, Calif.

Bitumastic coal-tar coating found durable

TO THE EDITOR: I would like to compliment Mr. Richardson on a most timely and interesting article concerning construction of the Callahan Tunnel under Boston Harbor (CIVIL ENGINEERING, January, p. 42). Mention is made that "a bitumastic enamel coating was specified, thus requiring extreme care in handling the plates so as not to damage the coating." Bitumastic is a registered trademark of Koppers Co., Inc., used to designate various products in the Koppers line of coal-tar protective coatings. Its misuse as a generic term is not uncommon.

Mr. Richardson may have unintentionally left the impression that the coating used was unusually delicate. Bitumastic coal-tar coatings have been used for more than half a century for underground pipelines, bridges, tanks and other structures where heavy-duty corrosion protection is vital. For the Callahan Tunnel, Koppers supplied Bitumastic jet-set primer and Bitumastic 70-B enamel and did the application for Commercial Shearing and Stamping Co., which fabricated the steel liner plates at Youngstown, Ohio. The finished plates were shipped to Boston, stored, then moved into the tunnel as needed.

An indication of the durability of the coating is suggested by the fact that an extra drum of the enamel coating—supplied to the job for touch-up purposes—was never needed and was not used.

R. A. SMITH
Manager, Advertising and Sales Promotion
Tar Products Division
Koppers Company, Inc.
Pittsburgh, Pa.

Seismic studies for projected San Francisco Bay tube

TO THE EDITOR: Consistent with the high standards of CIVIL ENGINEERING, we believe you will be interested in more comprehensive information on the engineering studies for the San Francisco Bay Area Rapid Transit District. The article, "Bottom of San Francisco Bay Evaluated for Trans-Bay Tube," by R. J. Swain in your November issue (p. 66) is somewhat fragmentary and contains a number of statements that should be qualified.

The studies described in the article were undertaken by a joint venture of Parsons Brinckerhoff-Tudor-Bechtel, under a contract with the San Francisco Bay Area Rapid Transit District. The contract required the joint venture to study the engineering feasibility of constructing a rapid transit tube under the bay between San Francisco and Oakland and to determine the cost of such a tube.

It was evident at the outset that little information existed regarding seismic effects in alluvial formations similar to those in the bottom of San Francisco Bay, and in which the tube would be constructed. Therefore the joint venture outlined certain tests to be performed to broaden our knowledge of seismic effects.

United Electro-Dynamics Inc. (UED) was selected from several proposers to provide the earthquake sensing and recording equipment described in the article, and to perform the Phase 1 elastic constants tests. This work was performed under a subcontract between UED and Parsons Brinckerhoff-Tudor-Bechtel. After the earthquake sensing system was installed, UED's relationship with the project was to supply recording instruments on a rental basis.

The recordings are the property of the San Francisco Bay Area Rapid Transit District and are analyzed by Parsons Brinckerhoff-Tudor-Bechtel and by Dr. George W. Housner, M. ASCE, of California Institute of Technology, who is retained by the joint venture as a consultant. Dr. Frank Press, who is mentioned in the article, has had no similar direct relationship with the project on a consulting basis.

Certain specific inaccuracies in the article require correction. In the first paragraph Mr. Swain indicates that the tunnel project has been authorized and that construction will begin after a study and evaluation program is completed. The study was initiated to verify certain assumptions that had been made in the preliminary design for the tube and it has no bearing whatever on the construction schedule for the project. Actually the under-water tunnel will not be constructed unless the District is successful in passing a bond issue for constructing a rapid transit system throughout the several counties that form the District.

The first phase of this study, which consisted of developing information regarding the elastic properties of the various alluvial layers in the bay bottom, was performed to check information developed by laboratory tests and other previous studies. Likewise, the second phase of the study, which consisted of the earthquake sensing and recording system, has been performed to develop information to substantiate certain theories and assumptions used in the preliminary design of the tube.

It has been a recognized fact that motions caused by earthquakes in softer alluvial materials are magnified from those in rock. The specific purpose of the seismic recording system was to endeavor to obtain data that could assist in evaluating the degree of magnification in the various consistencies of alluvial materials in the bay.

The present indications are that the earthquake stresses will not be governing factors in the design of the tube. The system has been discontinued after less than six months of successful recordings because of failures in components.

We have obtained very interesting recordings of several earthquakes, which have provided valuable seismic data and we were extremely disappointed in our inability to continue this system so that we may record information from other earthquakes, possibly of greater magnitude, that may occur in the future. Because of this we are currently replacing the components of the system that have failed.

The contract between Parsons Brinckerhoff-Tudor-Bechtel and UED provided for purchase of the earthquake sensing equipment installed in the bay and rental of the recording instruments. The rental contract has now been terminated and we are designing and installing a different recording system.

J. E. EVERSON, M. ASCE
Project Manager
Parsons Brinckerhoff-Tudor-Bechtel

San Francisco, Calif.

Author's reply

TO THE EDITOR: We appreciate the opportunity to comment on the above letter. The article was a factual description of: (1) the successful determination of in situ elastic properties of underwater sediments, and (2) a specially designed earthquake sensing and recording system to obtain relative earth motion amplitude information in these same underwater materials. This work required generation of shear waves in the bay bottom sediments and the underlying Franciscan structure.

To the best of our knowledge, this represents a new technique advancing the design capability of the civil engineering profession. For this reason we believed that prompt presentation of the method would be of general benefit to civil engineers.

The article makes no attempt to be a source of political, civic, financial, or for that matter, tunnel design information. The paragraph on the tunnel was intended to identify the location and the basic reason for undertaking the work. We are indebted to Mr. Everson for providing certain supplementary information to which we did not have direct access.

United ElectroDynamics is also disappointed that the recording program has been temporarily suspended because of a failure in the main underwater cable, which apparently occurred after submitting the article to CIVIL ENGINEERING. According to the January 1961 issue of *Rapid Transit*, published by the San Francisco Bay Area Rapid Transit District, the rupture was probably caused by a ship dragging anchor. However, we are pleased to note that Mr. Everson reports obtaining valuable seismic data.

The system went into operation on March 2, 1960, and was discontinued on October 20, 1960, during which time it accumulated over 5,500 hours of almost continuous operating time. As indicated by Mr. Everson, the rental contract has been terminated. During the recording period the equipment was under the jurisdiction of the Joint Venture. UED provided maintenance services only as requested, and in these instances returned the system to operating condition.

R. J. SWAIN
Manager, United GeoMeasurements Div.
United ElectroDynamics, Inc.

Pasadena, Calif.

Backfill around large metal culverts is important

TO THE EDITOR: The importance of proper backfilling and compaction around large metal culverts cannot be overstressed. Howard L. White discusses this in his article, "Largest Metal Culvert Designed by Ring Compression Theory," in the January issue, p. 52.

In late 1960, a metal pipe culvert having a diameter of 21 ft, or 2 ft larger than that described by Mr. White, was installed along Long Run in Versailles Township, Allegheny County, Pa. Largely because of improper backfilling and compaction, and possibly also because of inadequate bracing, the structure failed. Subsequently the structure was rebuilt under the close supervision of engineers of the Armco Drainage and Metal Products, Inc., and is proving to be satisfactory.

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Energy equation for partially developed free-surface flow

CARL E. KINDSVATER, F. ASCE, Professor, Georgia Institute of Technology, Atlanta, Ga., and Consultant, U.S. Geological Survey

When the one-dimensional continuity and energy equations are applied to the flow of liquids through short transitions in open channels, effects related to boundary resistance are usually ignored. Occasionally, however, it is necessary to account for the non-uniform velocity distribution in the partially developed boundary layer. Requirements of the occasion may make it expedient to write the equations in terms of boundary-layer parameters.

The continuity equation is conveniently adapted to the concept of the boundary-layer displacement thickness, δ_q. In Fig. 1 are shown δ_q and the quantities which are used to describe it. In the equation

$$q = (y - \delta_q)U \quad \ldots \quad (1)$$

q is the discharge per unit width of channel, y is the depth of flow, and U is the potential velocity in the region outside the boundary layer.

If the quantity U (δ_q) is described as the decrement of discharge due to the boundary layer, it follows that

$$U\,\delta_q = \int_o^y (U - u)dy \quad \ldots \quad (2)$$

$$\delta_q = \int_o^y \left(1 - \frac{u}{U}\right) dy \quad \ldots \quad (3)$$

in which u is the velocity at distance z from the boundary. From Eq. 3 it is evident that δ_q depends only on the velocity distribution in the boundary layer.

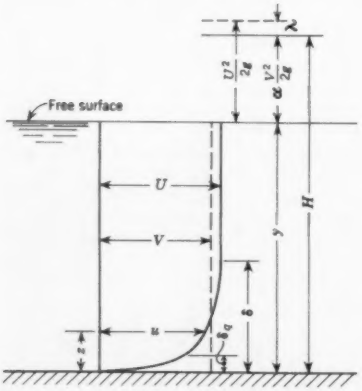

FIG. 1. Partially established boundary-layer flow.

Whereas its use in the continuity equation is undisputed, δ_q has been used with less justification in approximations of the one-dimensional energy and discharge equations (A. T. Ippen, p. 527, *Engineering Hydraulics,* edited by Hunter Rouse, John Wiley and Sons, 1950; and J. W. Delleur, "The Boundary Layer Development in Open Channels," Paper 1138, ASCE, *Journal of the Engineering Mechanics Division,* Jan. 1957). The alternative here proposed was evolved in connection with a study of embankment-shaped weirs ("Discharge Characteristics of Embankment-Shaped Weirs," by C. E. Kindsvater, U. S. Geological Survey Water-Supply Paper, publication pending).

From Fig. 1, the true average total head (energy per pound) is

$$H = y + \frac{U^2}{2g} - \lambda \quad \ldots \quad (4)$$

in which λ is defined by the equation

$$\lambda = \frac{U^2}{2g} - \alpha\frac{V^2}{2g} \quad \ldots \quad (5)$$

In Eq. 5, α is the so-called Coriolis coefficient, V is the average velocity, and $(\alpha V^2)/(2\ g)$ is the true velocity head. Thus, from the definitive relation

$$\alpha\frac{V^2}{2g} = \frac{1}{2gq}\int_o^y u^3 dy \quad \ldots \quad (6)$$

it follows that

$$\lambda = \frac{1}{2gq}\int_o^y (U^2 - u^2)u dy \quad \ldots \quad (7)$$

or, from Eqs. 1 and 7,

$$\lambda = \frac{U^2/2g}{y - \delta_q}\int_o^y \frac{u}{U}\left[1 - (u/U)^2\right]dy \quad \ldots \quad (8)$$

It is now apparent that λ, unlike δ_q, depends on q and y as well as the velocity distribution. More significantly, the ratio which precedes the integral in Eq. 8 is proportional to a Froude number. (Of incidental interest, too, is the fact that the integral is equivalent to the "energy thickness" of the boundary layer, δ_e. In other words, $\lambda \propto F^2\,\delta_e$).

Although it is obvious that δ_q and λ are independently significant quantities, the contrast is best illustrated in terms of an assumed velocity distribution. For intermediate values of the Reynolds number, the velocity distribution in partially developed free-surface flows is closely approximated by an equation of the power form,

$$u/U = (y/\delta)^n \quad \ldots \quad (9)$$

in which δ is the nominal boundary-layer thickness, and n is an experimentally determined exponent. From Eqs. 3, 8, and 9,

$$\delta_q = \left(\frac{n}{n+1}\right)\delta \quad \ldots \quad (10)$$

and

$$\lambda = \frac{U^2/2g}{y - \delta_q}\left[\frac{n}{(3n+1)(n+1)}\right]\delta \quad \ldots \quad (11)$$

or,

$$\lambda = \frac{U^2/2g}{y - \delta_q}\left(\frac{1}{3n+1}\right)\delta_q \quad \ldots \quad (12)$$

An average value of n for smooth surfaces is 1/7. If this value is substituted in Eqs. 10. 11, and 12,

$$\delta_q = \frac{1}{8}\,\delta \quad \ldots \quad (13)$$

and

$$\lambda = \frac{U^2/2g}{y - \delta_q}\left(\frac{7}{80}\right)\delta \quad \ldots \quad (14)$$

or

$$\lambda = \frac{U^2/2g}{y - \delta_q}\left(\frac{7}{10}\right)\delta_q \quad \ldots \quad (15)$$

Eqs. 12 and 15 show that the relationship between λ and δ_q depends on a ratio which is proportional to the Froude number. Both λ and δ_q depend on the velocity distribution in the boundary layer.

It is believed that the concept embodied in the quantity λ can be used effectively to describe the influence of boundary resistance on partially developed free-surface flows. One such application, for example, leads to an analytical discharge equation for critical-flow control sections. Studies completed to date promise limited success in computing δ_q and λ from general equations for the growth of the boundary layer.

Deflections of beams with internal hinges

J. L. SACKMAN, A.M. ASCE

Assistant Professor of Civil Engineering, University of California, Berkeley, Calif.

The advantages of using operational notation in beam deflection problems are now so well recognized that the method is even beginning to appear in modern undergraduate textbooks on mechanics of materials. (See *An Introduction to the Mechanics of Solids*, by S. H. Crandall and N. C. Dahl, McGraw-Hill Book Co., Inc., 1959.) My purpose here is to point out that this convenient method may be very simply extended to include beams with internal hinges.

Usually, to find deflections of beams with internal hinges, portions of the beam between hinges are treated separately, and then deflections at the hinges are matched. This somewhat awkward approach could be avoided if a single mathematical expression were known for M/EI which would be valid over the entire beam, even at the internal hinges. Such an expression can be written. It is the usual expression for M/EI—most conveniently written utilizing step functions if the customary M/EI expression (or its derivatives) has jump discontinuities—plus delta functions of suitable strength located at the sections where the internal hinges occur.

By considering the elastic curve of the beam and the differential equation governing the elastic curve, $y''= M/EI$, it can be ascertained that delta functions should be included at the internal hinges in the M/EI expression. In general, kinks occur at the hinges. Thus at a hinge the slope has a jump discontinuity, which means that y'', and hence M/EI, has a delta function behavior there. The strength of the delta function is given by the magnitude of the jump discontinuity of the slope (that is, by the sudden change in angle) at the internal hinge. Of course, this quantity is generally unknown at the outset of a problem but, as will be illustrated, is readily obtained from the given conditions of the problem.

The advantages of using this approach in the double-integration method are obvious. It is no longer necessary to break up the integration range at an internal hinge and then, in order to evaluate the arbitrary integration constants, satisfy deflection conditions both at supports and internal hinges. With the single expression for M/EI, the integration can be carried out over the entire beam length and the arbitrary constants of integration, as well as the unknown strengths of the delta functions at the hinges, are obtained by satisfying conditions only at the supports. Continuity of deflections at the hinges is automatically satisfied since the delta functions become continuous after two integrations.

When the moment-area method of obtaining beam deflections is employed, the advantages of introducing delta functions at the internal hinges are even more striking. These delta functions can be shown on the M/EI diagram as areas concentrated at the hinges. For example, see Fig. 1(b). Their magnitudes are determined by the moment-area theorems, making use of the given support conditions. It is noted that the moment-area theorems (which can be derived by suitable integration of $y''= M/EI$) are completely valid across an internal hinge if M/EI is considered to have a delta function behavior of suitable strength at the hinge.

Example

To illustrate the simplicity of this method, consider the elementary problem of a statically determinate beam of constant stiffness shown in Fig. 1(a). It is desired to determine the deflection under the load, and also to determine sudden changes in the angles of inclination of the tangents to the elastic curve at the hinges—that is, $\Delta\theta_B$ and $\Delta\theta_D$ in Fig. 1(c). Figure 1(b) shows the usual M/EI diagram (computed from statics) with the additional concentrated areas K_BPa^2/EI and K_DPa^2/EI at the hinges.

First the unknown constants K_B and K_D are determined by utilizing the second moment-area theorem and the support conditions. (The notation and sign convention are those of *Mechanics of Materials*, by E. P. Popov, Prentice Hall, Inc., 1952.)

To determine K_D:

$$t_{BA} = t_{BE}\text{: } -3(3/2)(2) = 1(2/2)(1) + K_D(2) - 1(1/2)(8/3)$$

Whence $K_D = -13/3$ and thus

$$\Delta\theta_D = -(13Pa^2/3EI) \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

To determine K_B:

$$t_{DA} = t_{DE}\text{: } -3(3/2)(4) + K_B(2) + 1(2/2)(1) = -1(1/2)(2/3)$$

Whence $K_B = 25/3$ and thus

$$\Delta\theta_B = 25\,Pa^2/3\,EI \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

The deflection under the load, δ_c, is given by:

$$\delta_c = -t_{CA} = [Pa^3/EI]\ [3(3/2)(3) - K_B(1) - 1(1/2)(1/3)]$$

Whence $\delta_c = 5\,Pa^3/EI$. . . . . (3)

As a check:

$$\delta_c = -t_{CE} = [Pa^3/EI]\ \ [1(1/2)(5/3) - K_D(1) - 1(1/2)(1/3)]$$

Whence $\delta_c = 5\,Pa^3/EI$.

The solution by this method is simple and straightforward whereas the solution by the conventional method is considerably more involved. As a matter of fact, the conventional solution just represents a particular (inefficient) utilization of the "ammended" M/EI diagram which does not make use of the concentrated areas at the hinges. The approach proposed here should prove useful in many situations involving beams with internal hinges; it increases the number of ways in which such problems can be solved.

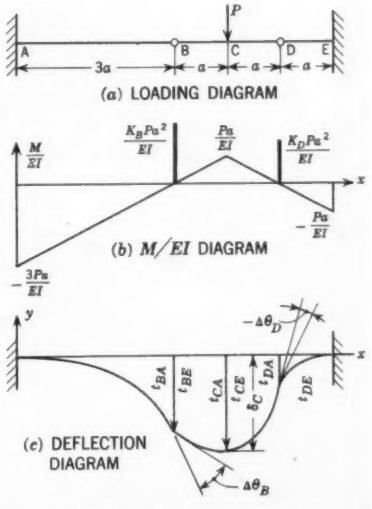

FIG. 1. Statically determinate beam of constant stiffness.

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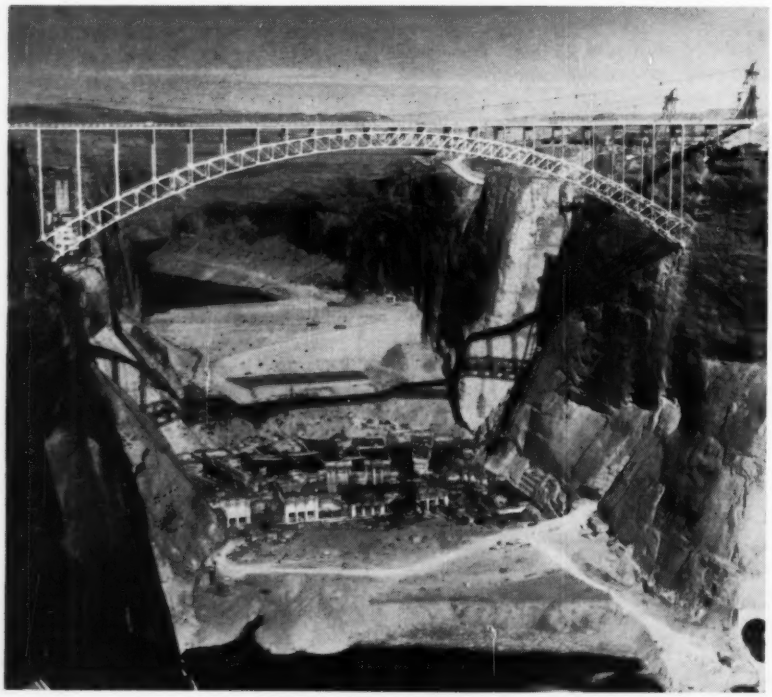

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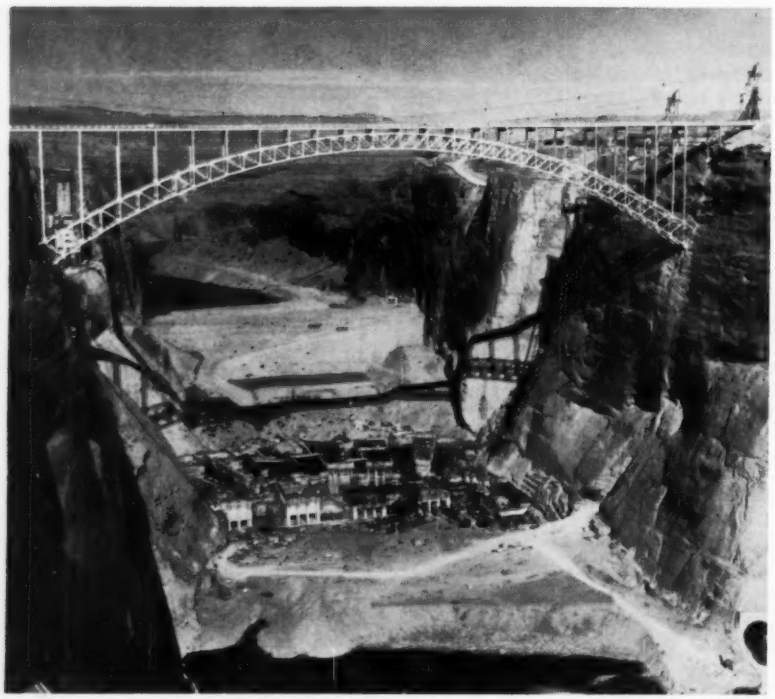

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Future of EJC Studied at Annual Meeting

More than 100 officers and representatives of engineering societies attended the annual meeting and general assembly of Engineers Joint Council, held in New York on January 19. In the featured luncheon speech Col. Daniel O. Omer, deputy director of the U.S. Selective Service System, explained the place of the engineer in the nation's defense program.

According to Colonel Omer, engineers in essential occupations are deferred with respect to military service until age 35. However, he pointed out that there is no blanket deferment for engineers as such. At Cape Canaveral, the missile launching site, civilian engineers are performing essential services and, in peacetime, the Selective Service System concludes that such activity is perhaps better done under civilian rather than military status.

Colonel Omer felt that the System had built an efficient organization, trained to do a job in the best interests of the country and that it would resist any drastic change in policy which would radically interrupt the orderly processes which had been so long in building to its present status.

He had a word of advice for individual engineers and industry. To avoid unnecessary interruptions in our industrial economy, which the System is just as interested in keeping strong as the armed services, he urged the individual engineer in the appropriate age group to keep his draft board informed of his occupation. He also asked industry to catalogue its employees with respect to draft status, so that, in the event of an emergency, there would be a minimum of disruption, especially in those industries closely identified with defense activity.

The keynote of the afternoon program was a panel discussion on "The Future of EJC," moderated by outgoing EJC President Augustus B. Kinzel. Participants were James N. Landis, the incoming president, who spoke on "The Role of EJC"; George Browne, chairman of the Committee on International Relations, whose subject was "International Opportunities and Obligations"; George E. Holbrook, vice-president of EJC, with a talk on "Interdisciplinary Cooperation and Coordination"; T. O. Paine, technical secretary, Committee on Engineering Research, who discussed "Engineers and the Needs of Society"; R. Carl Honaman, chairman, Committee on Engineering Services, whose topic was "Information Flow—Problems and Needs"; Sydney B. Ingram, chairman of the EJC Engineering Manpower Commission, who spoke on "Engineering Manpower—Perspective of the 60's"; and Morris Hooven, chairman of the EJC-ECPD Joint Committee on Survey of the Profession, whose topic was "The Engineering Profession—A Need for Evaluation."

Officers for 1961, installed during the meeting, were: James N. Landis, president; George E. Holbrook, vice president; E. L. Chandler, treasurer; and L. K. Wheelock, secretary.

Top-echelon ASCE members get together during EJC annual meeting. Reading left to right are Frank L. Weaver, former Director and Vice President; Past President Enoch R. Needles; Past President Louis R. Howson; Jewell M. Garrelts, former Director; E. Lawrence Chandler, Treasurer of ASCE and EJC; and Samuel B. Morris, former Director and Vice President.

New ASCE Manual of Practice Available

A new ASCE Manual of Engineering Practice—No. 40 in the series—is now available and may be ordered from Society headquarters. Prepared by the Irrigation and Drainage Division's Committee on Ground Water, the new Manual deals with the operation and management of groundwater resources for irrigation and other beneficial uses. It will be especially helpful in the planning of water development projects and in designing and programming facilities for controlled conjunctive operation of surface and ground-water reservoirs in order to make maximum use of available water supplies.

The Committee on Ground Water has spent several years in the preparation of Manual No. 40, a companion to the Hydrology Handbook, Manual 28. To facilitate ordering, a coupon has been provided on page 125.

ASCE Manual on Sewer Design and Construction

ASCE Manual No. 37, "Design and Construction of Sanitary and Storm Sewers", issued in early 1960 as a joint effort with the Water Pollution Control Federation, is now available in a reprint incorporating corrections to several pages. Those who have a copy of the 1960 edition can obtain, with the compliments of the Society, a reprint containing the corrected pages. The reprint can be cut apart and the pages inserted in the previous edition.

The twelve-chapter Manual contains 283 pages of text, 102 illustrations, 24 tables, and 119 references. As the first extensive reference on the subject, it is a valuable addition to the field of waste-water technology. Subjects covered include organization and administration of sewer projects, surveys and investigations, quantity of sanitary sewage and storm water, hydraulics of sewers, design of sewer systems, appurtenances and special structures, materials for sewer construction, structural requirements, construction plans and specifications, construction methods, and pumping stations.

Manual No. 17 may be ordered by use of the coupon on page 125. The list price is $7.00 per copy, with a 50 percent discount to ASCE and WPCF members and to libraries.

ASCE Executive Committee Meets in Columbia, S.C.

The Executive Committee of the Society met in Columbia, S.C., on January 27 to take action on matters referred to it by the Board of Direction or matters requiring action before the Board meets during the Phoenix Convention in April.

Education Advisory Group

Upon recommendation of the Committee on Engineering Education, a five-man Advisory Group, including representation from ASEE and ECPD, has been formed to assist the CEE in analyzing the results of the balloting on the resolutions proposed at the 1960 Conference on Civil Engineering Education, held in Ann Arbor, Mich., in July (August 1960 issue, page 106, and January 1961 issue, page 56). At the request of CEE, the Executive Committee voted to approve a special appropriation of $750 to finance a two-day joint meeting of the Advisory Group with the CEE.

Joint Management Conference

In recent years ASCE has participated with ASME and AIEE in conducting joint conferences on engineering management. Although these conferences have been self supporting, the sponsoring societies have been asked to assume token financial responsibility as evidence of their interest. The Executive Committee authorized participation by ASCE as a full sponsor in the 1961 Joint Engineering Management Conference.

Samuel F. Tapman bequest

Under the terms of the will of the late Samuel F. Tapman, the Society has received a bequest of $120,000 "to be invested . . . in perpetuity and the income therefrom used to make grants to members of Student Chapters of said Society who desire to continue their education and who, in the opinion of the Society, are worthy of such aid or grant." The Executive Committee enthusiastically recommended to the Board of Direction that the bequest be accepted. As a result of Mr. Tapman's generosity, four or more annual scholarships, with top value of $1,000 each, will be available to Student Chapter members—one in each Zone. The first awards will be made for the school year beginning in September 1962.

Chi Epsilon contribution to UEC

The Committee voted to accept an offer from Chi Epsilon, honorary civil engineering fraternity, to furnish and equip the Conference Room on the 18th floor of the new United Engineering Center as a means of active participation in the UEC project. (Chi Epsilon is seeking to raise about $10,000 for its contribution to the UEC project.)

McCamy Case resolution

For the record, the Secretary reported that the McCamy Case resolution—developed by a Tripartite Committee representing ASCE, the American Institute of Consulting Engineers, and the Consulting Engineers Council—had been approved by mail ballot of the Executive Committee. The resolution was prepared by the Tripartite Committee at the request of the Attorney General of New Jersey for suggestions, from local engineering and architectural societies, for revising the present New Jersey law requiring architectural services on all building projects.

(It will be recalled that the McCamy Case concerned the right of Wm. J. McCamy, a professional engineer, to design a country club without benefit of architectural services. This right was questioned by local architectural societies, although no criticism of Mr. McCamy's work was implied. The Tripartite Committee resolution stated, in part, "That ambiguity in the laws is not in the public interest," and "That owners of structures, or owners' agents, shall have the unrestricted right to determine whether they wish to retain an Engineer or an Architect to plan, design, coordinate, and supervise their project." Several Local Sections of ASCE and the New Jersey Society of Professional Engineers have been active in upholding the engineers' rights in this case.)

Student Chapter authorized

On recommendation of the Committee on Student Chapters, the Executive Committee voted to authorize formation of an ASCE Student Chapter at the University of Miami.

Outstanding Achievement Award

The Executive Committee voted to approve the report of the Jury of Judges recommending that the New York International Airport be selected for the 1961 Outstanding Civil Engineering Achievement Award. Details of this year's award are reported on page 46.

Replacement for Director Scalzi

John B. Scalzi, who became ASCE Director for District 9 last October, has moved out of the District. Local Sections in the District have been asked for nominations to fill the vacancy. These nominations will be considered by the Board of Direction at its Phoenix meeting. In the meantime, Mr. Scalzi will continue to represent District 9 until his successor has been selected and qualifies.

O. H. Ammann Receives Howard Award

President Holcomb (left) presented the Society's Ernest E. Howard Award to O. H. Ammann, Hon. M. ASCE, distinguished consulting engineer, at a recent meeting of the Metropolitan Section. Section President Robert Dodds is seen at right. Mr. Ammann, who was last year's winner, was unable to receive his prize at the Boston Convention. He was honored "for design and construction of outstanding bridges of record dimension and large engineering works."

CONFERENCE ON ENVIRONMENTAL ENGINEERING AND METROPOLITAN PLANNING

NORTHWESTERN TECHNOLOGICAL INSTITUTE, EVANSTON, ILLINOIS — MARCH 21-22

. . . a working session for civil engineers, city planners, public health specialists and governmental officials—to consider both the goals and the means for positive action toward the achievement of a more satisfactory environment in metropolitan areas.

PAPERS | **PLANNED DISCUSSION** | **OPEN DISCUSSION** | **WORKSHOPS**

Morning and afternoon meetings will be held both days in the auditorium of the Technological Institute. Also featured are lunches both days and a dinner meeting on Tuesday.

TOPICS—Liquid Waste Pollution . . . Air Pollution . . . Solid Waste Problems . . . Environmental Health Criteria for Metropolitan Areas . . . Planning Criteria for Metropolitan Areas . . . Cost of Environmental Health . . . Water Supply

Sponsored by:
ASCE City Planning Division
ASCE Sanitary Engineering Division
Northeastern Ill. Metropolitan Planning Commission
Tech. Inst. of Northwestern Univ.
U.S. Public Health Service

FOR FURTHER INFORMATION:

PROGRAM:
Dr. John A. Logan, CONFERENCE CHAIRMAN
Department of Civil Engineering
Northwestern Technological Institute

RESERVATIONS:
Orrington Hotel
Evanston, Illinois

PLAN NOW TO ATTEND

Melbourne to Be Host to World Power Conference

The U.S. National Committee of the World Power Conference has initiated plans for taking part in the Sixth Plenary Meeting of the Conference, to be held in Melbourne, Australia, October 20-26, 1962. Meeting in Washington this January, the U.S. Committee appointed a task force to select authors and subjects for the U.S. technical program. Twenty technical papers have been allotted to the United States by the Australian National Committee, host for the 1962 meeting. A list of the authors and papers, with a brief outline of each, must be furnished the Australian Committee by June 30, 1961.

"The Changing Pattern of Power" will be the theme of the conference. In developing this theme, the program will emphasize the changes that have taken place in power production, transportation, and utilization techniques since the Fifth Plenary Meeting in 1956, and include forecasts for the future. The papers and discussions will be grouped into the following categories:

Division I provides for (*a*) discussion of energy resources based on the World Power Conference Survey of Energy Resources and the United Nations "J" series of publications, and (*b*) summaries prepared by each National Committee dealing with past and expected developments in the exploitation and use of all primary sources of energy.

Division II provides for papers dealing with the production and amelioration of primary sources of energy.

Division III covers the transformation of primary to secondary energy and transportation of energy.

Division IV deals with the utilization of primary and secondary energy with subdivisions determined on the basis of broad classes of user.

Division V will be devoted to economic evaluation of alternative energy sources.

The World Power Conference Survey of Energy Resources, to be discussed under Division I, will be released as a new publication prior to the Melbourne meeting. It will replace the former World Power Conference Statistical Year Book and will be issued at six-year intervals on the occasion of each Plenary Meeting.

The U.S. Committee, one of 59 National Committees from all over the world making up the membership of the World Power Conference, is composed of three major groups of participating members. They are (1) the professional engineering societies, including the five Founder Societies; (2) the industrial, utility, or similar associations, such as the Association of Edison Illuminating Companies, Edison Electric Institute, and the American Gas Association; and (3) federal and state government bodies, including the Atomic Energy Commission, Federal Power Commission, Bureau of Mines, Bureau of Reclamation, the U.S. Army Corps of Engineers, and Rural Electrification Administration.

The affairs of the U.S. Committee are managed by an executive board of nine members, consisting of three members from each of the three participating groups. The secretariat for the committee is furnished through the Engineers Joint Council, 29 West 39th Street, New York 18, N.Y. All communications should be addressed to the Secretary, U.S. National Committee, World Power Conference, at that address.

ASCE is represented on the U.S. National Committee by Past Presidents Gail A. Hathaway and Francis S. Friel.

The World Power Conference, formed in 1924, is a non-government international organization with headquarters in London, England. Its objectives, as stated in its constitution, are "the development and peaceful use of energy resources to the greatest benefit of all, both nationally and internationally."

International Current Meter Group Formed

Activities of the recently formed International Current Meter Group—established by seven countries in 1959 under the chairmanship of Professor Gerber, of the Swiss Federal Institute of Technology—are of interest to civil engineers. Members meet once a year to review progress in the current-meter technique of flow measurement. This form of gauging is used almost exclusively on the Continent for hydroelectric power-station measurements. The group was formed with the aim of coordinating research in certain aspects of current-meter performance and calibration procedure that are thought to need further clarification. This research has been in progress for a number of years in the United States as well as in Europe.

It is hoped that the work of the new international group will encourage the development of advanced methods and instrumentation. The group is interested in receiving information on current-meter performance or measurements of unusual interest. Contributions will also be appreciated. Either or both should be addressed to Dr. F. A. L. Winternitz, Secretary-ICMG, National Engineering Laboratory, East Kilbride, Glasgow, Scotland.

ASCE Membership as of February 9, 1961

Fellows	11,174
Members	16,334
Associate Members	19,026
Affiliate Members	114
Honorary Members	47
Total	46,695
(February 9, 1960	44,767)

Engineers Can Improve U.S.-Latin American Relations

The first New York report on their 11,000-mile, people-to-people, engineers-to-engineers mission to Latin America was made by Rodney Chipp, director of engineering planning for ITT Federal Laboratories, and Dr. Beatrice Hicks, president of the Newark Controls Company, at a meeting sponsored by the New York Section of the Society of Women Engineers on February 9.

Mr. Chipp and Dr. Hicks are a husband-and-wife team of engineers, who visited South America last year under a project set up by the National Society of Professional Engineers to explore problems and relationships of U.S. engineers working in Latin America. Their trip included visits to some of the major industries of Brazil, Uruguay, Argentina, Chile, and Peru. As guests of the leading South American engineering societies, they also had a chance to see engineers, educators, government officials, and industrialists.

They found that, since World War II, practically every South American country has given top priority to industrial development. As a result of population growth and industrial expansion there will be tremendous need for goods and services from other countries. Industrially speaking, they found South America at a "stage of progress similar to that of the United States in the period 1910 to 1920. The distribution of engineers among the various disciplines is quite different from our own present-day picture. They follow the pattern of our own country as it has progressed under the Industrial Revolution. Those countries least industrialized tend to have a predominant proportion of civil engineers." Strangely enough, the percentage of women in South American engineering schools is about the same as the United States.

Mr. Chipp and Dr. Hicks reported that engineers, like other U.S. visitors to South America, should be considerate guests. More than that, they must learn to be genuinely responsive to attitudes and customs different from their own. One very obvious and very important courtesy that the engineer going to South America to work should observe is to learn Spanish or Portuguese (if he is going to Brazil) before he goes.

United Engineering Center

Extreme winter weather in New York has slowed construction on the exterior of the UEC building. Work has continued on the enclosed lower floors to meet an August completion date.

THE YOUNGER VIEWPOINT

Committee on Younger Member Publications
Walter D. Linzing, Chairman; 4751 No. Paulina, Chicago 40, Ill.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko	Albert C. Nelson	William R. Walker	Judd Hull
289 Foxhill Road	250 N.E. 51st Street	4600 Franklin Ave.	6000 S. Boyle Ave.
Denville, N. J.	Miami, Fla.	Western Springs, Ill.	Vernon, Calif.

This month's editor is Walter Linzing, chairman of the Committee on Younger Member Publications.

The reader will observe that this month's correspondent—Swen Johnson, A.M. ASCE, Chicago, Ill.—has done some extensive thinking on professional subjects. Mr. Johnson's thought-provoking letter follows:

New name for engineers—a la Plato

"In recent months we have seen and heard a tremendous amount of material and discussion about the 'engineering profession.' What is an engineer? Are engineers professional? What is professionalism? These are but a few of the questions that have been asked, and it seems that each individual has a different definition of the two words, 'professional' and 'engineer.'

"There is definitely confusion within the vocation of 'engineering' as to the responsibility and duties of an engineer. There are many individuals of varying abilities who call themselves engineers. Operating Engineers, Sales Engineers, Stationary Engineers, and Civil Engineers are only a few uses for the title 'Engineer.' Industry has added to the confusion by grouping everyone from technician to scientist in the category of engineer.* This has completely concealed the responsibility and duties of engineers from the American public. This points to the fact that the word engineer covers too great a field of endeavor.

"By using the word 'professional,' I believe we have attempted to associate ourselves with the three learned professions. This is something I believe we do not deserve at this time because of our relationship to society. And could it be that we are only envious of the income rather than their responsibility to society. Let us not make money an issue of our discussion. Monetary remuneration comes with quality and importance of work accomplished.

"I believe that it is time for us to rename and reorganize the entire structure of the 'engineering profession.' Let us take the initiative. Let us give up the titles of 'engineer' and 'professional.'

Are you a Dialectic?

"I would like to suggest a few points for the purpose of discussion. Let us assume that we adopt a new title, 'Dialectics.' Dialectic, according to Plato, is the logical process by which we learn to use the facts and theories of science, not as final results, but as points from which to gain an understanding of the higher abstractions, such as Truth, Justice and Goodness.†

"This definition seems to exclude many individuals who now call themselves 'engineers.' And I hope that it does not exclude all of us who have fulfilled some educational requirements. We could distinguish those that are permitted by law to practice 'engineering' by calling them registered 'dialectics.'

"With a new name, it will become easier to reorganize all the existing societies into one governing body with many different senates. Each of the existing societies could assume the responsibility of a senate.

"I have oversimplified the problem, but I believe that we must start from the beginning because the confusion does not seem to clear. Many will argue that we will be giving up what we have already accomplished. This is not true if we only change our names and not our purpose.

"I believe that this will help us maintain complete freedom from union control and, in the future, society may see 'dialectics' as professionals.

"I do not want a new society formed that would not encompass all existing societies because this would only add to the confusion. If there is anyone interested in pursuing this line of thinking, please send your ideas. The younger members must take the initiative!"

*This has helped unions make inroads in the field of "engineering."

†Plato, translated by B. Jowett.

[*Editor's Note*: One of the projects of the Recognition Committee of Engineers Council for Professional Development is finding a new name for the profession. The study has been under way for several years.]

ECPD Committee states aims

A recent communication from the ECPD Committee on Development of Young Engineers calls attention to the need for after-college professional development of the young engineer. It states:

"Engineers are costly for society to produce. They are expensive to maintain. Their output is important to our continued growth, to our high standard of living, and in these times, particularly, to the safety of our country. It is most important that this valuable resource be used to its maximum.

"The process by which a young engineer is effectively fitted to a job can be a short one or a long one but in any case it involves three steps: (1) finding the job, (2) learning the job, and (3) growing in the job.

"Finding the right job needs attention. Because of the rapid development of science the problems of adapting a particular capability to a particular task, both of which are changing rapidly, is formidable. Learning the job after one gets it may be routine but keeping up is not. Someone has said that the half life of an engineer's education is 15 years. If this is true the technical deterioration of a man's education is at the rate of 3 percent a year. If we are not to lose this technical capability, a constant effort must be made to keep our people abreast of the times and also working on those jobs for which they continue to be best fitted. This effort must not be left to chance nor made exclusively dependent on good notivations or the judgment of our young engineers, but it must also be purposely planned and purposely fostered by responsible executives in industry, professional organizations, and colleges.

"The ECPD's Committee for the Development of Young Engineers has addressed itself to these purposes. The building blocks of the plan are: (1) career orientation, (2) continuing education, (3) professional identification, (4) responsible citizenship, (5) selected reading, and (6) personal appraisal.

"The means of implementation are through community action, through action of the professional societies, through industry and its training and professional development programs, and through schools, particularly those concerned with night classes and graduate activity.

"Specifically, we feel that a wide distribution of literature which ECPD has prepared and discussions of the points brought up in this literature can go far toward doing the job."

Information on ECPD's publications can be obtained by writing to: Engineers' Council for Professional Development, 29 West 39th Street, New York 18, N. Y.

Associate Members—Material for The Younger Viewpoint need not be controversial. The only requirement is that it be interesting and useful to other engineers. Send your ideas, now, to your Zone representative listed at the top of the page.

ASCE CONVENTIONS

PHOENIX CONVENTION
Phoenix, Ariz.
Hotel Westward Ho
April 10-14, 1961

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 16-20, 1961

HOUSTON CONVENTION
Houston, Tex.
Hotel Shamrock
February 19-23, 1962

TECHNICAL DIVISION MEETINGS

POWER CONFERENCE
Chicago, Ill.
Sherman Hotel
March 21-23, 1961
Co-sponsored by
Power Division

CONFERENCE ON ENVIRONMENTAL SANITATION AND URBAN PLANNING
Evanston, Ill.
Northwestern Technological Institute
March 21-22, 1961
Sponsored by
Sanitary Engineering Division
City Planning Division

AIR TRANSPORT CONFERENCE
Miami Beach, Fla.
Carillon Hotel
May 11 and 12, 1961
Sponsored by
Air Transport Division
Airport Operators Council

SYMPOSIUM ON WATER RESOURCES AND RECLAMATION
Fort Collins, Colo.
Colorado State University
June 12-15, 1961
Sponsored by
U.S. Bureau of Reclamation
Colorado State University
ASCE

DISTRICT CONFERENCES

NEW ENGLAND COUNCIL
Boston, Mass.
Massachusetts Institute of Technology
March 25, 1961

PACIFIC SOUTHWEST COUNCIL
Phoenix, Ariz.
Hotel Westward Ho
April 10-14, 1961

PACIFIC NORTHWEST COUNCIL
Spokane, Wash.
Davenport Hotel
April 21-22, 1961

NOTES FROM THE LOCAL SECTIONS

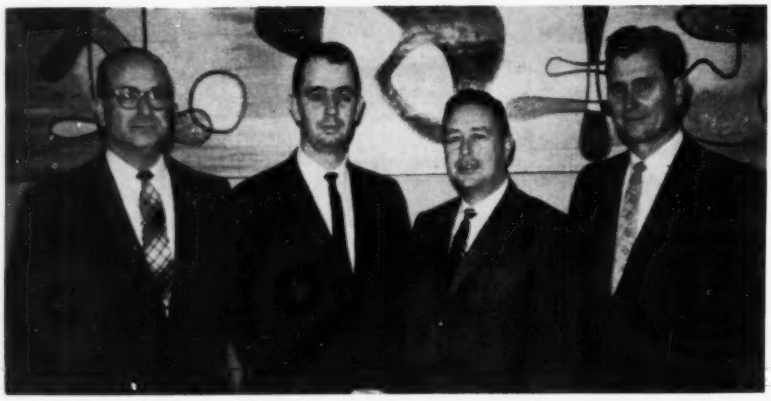
(Copy for these columns must be received by the fifth of the month preceding date of publication)

Over 200 members and students of the **Alabama Section** converged on Birmingham recently from all parts of the state to attend the section's two-day annual meeting. Lloyd R. Belcher, chief structural engineer of the Rust Engineering Company, described the 351,000-sq ft production and warehouse area of the Gates Rubber Company plant near Nashville, Tenn. William Chapman, project engineer for the Morrison-Knudsen Company, spoke on the 60-in. dia, 34.5-mi steel pipe line from Lewis Smith Dam to Birmingham, which will add 713 mgd safe dry weather yield to the city's industrial water supply. A field trip followed to the nearly completed dam. Officers for 1961, elected at the meeting, are Harry E. Myers, president; Prof. M. S. Priest, first vice president; W. F. Land, second vice president; and Powell Williams, Jr., secretary-treasurer.

At its annual fall meeting held recently in Phoenix, the **Arizona Section** heard several reports of local progress in flood control, highway construction, and public buildings. On the topic of flood control, A. L. Mitchell, construction and river control division chief for Region 3 of the U.S. Bureau of Reclamation, said that since Hoover Dam was built, the lower Colorado has remained under control and there never has been a shortage of irrigation water in the Colorado River Basin. Warning of mounting traffic problems, William E. Willey, Arizona state highway engineer, reviewed the proposed, 20-year, $375-million Phoenix urban arterial highway construction program awaiting approval by the State Highway Commission. The plan is based on a population expectancy of 1,250,000 in 1980 with an increased traffic flow amounting to three times that at present. At a joint luncheon with the Phoenix Chapter of the American Association of Engineers, Life Membership Certificates were presented to R. Gail Baker, former Phoenix city engineer, and William C. Lefebvre, state highway engineer from 1946 to 1951. The last item of business was installation ceremonies, in which Edward C. Fraedrich became president; Quentin M. Mees and Robert G. Welman, vice presidents; and James H. Deatherage, secretary-treasurer. Directors are Andrew B. Marum, Jake T. Doss, and Terrel C. Eubank.

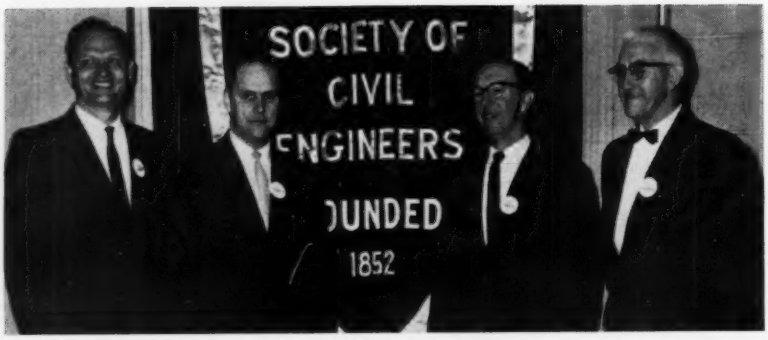
Dr. Evert Arne Bjerhammer, visiting lecturer from the Royal Institute of Technology at Stockholm, Sweden, discussed electro-optical distance-measuring devices at a recent meeting

Delaware's Governor Elbert N. Carvel (third from left) signs a declaration proclaiming the week of February 19-25 Engineers' Week in Delaware. Flanking the Governor, in usual order, are Ralph W. Smith, ASME; William J. Miller, Jr., ASCE; George W. Dutcher, ASCE; Robert E. Seddon, AIEE; and Chauncey O. Simpson, ASCE.



Northwestern Branch of the Indiana Section elected new officers at a recent meeting. Shown, left to right, are Prof. David I. Bolden, vice president; Richard O. Albright, president; W. W. Webb, retiring president; and Ed Gedrich, secretary-treasurer. The speaker for the evening was Paul Rampson, of the American-Marietta Company, whose topic was "Precast Concrete Panels for Chicago's New Exposition Hall."

R. Robinson Rowe (seated right) was honored recently by the Sacramento Section on his retirement as principal bridge engineer for the California State Division of Highways after 26 years with the state. Among the many on hand to pay tribute to Mr. Rowe, a former Director of ASCE and a past president of the Sacramento Section, were National President Glenn W. Holcomb (standing left), Zone IV Vice President Lawrence A. Elsener (seated left), and Director Harmer E. Davis.



The Orange County Branch of the Los Angeles Section held its installation dinner on January 5. From left to right are 1961 officers: Dwight Schroeder, secretary-treasurer; Floyd McLellan, Jr., vice president; Joseph Truxaw, president; and retiring President James Ballinger. John B. Davidson, president of the Adventurer's Club, Los Angeles District, and a retired district highway superintendent for the California State Highway Department, was guest speaker.

of the **Central Pennsylvania Section** held at Pennsylvania State University. A tour of the new college of engineering building and of the research equipment utilized for fly ash concrete and river hydraulics projects preceded the meeting.

Approximately 75 people attended the recent annual convention of the **Florida Section,** hosted this year by the **Florida East Coast Branch.** Three outstanding engineers took part in the afternoon technical session. D. E. Eppert, area engineer, Corps of Engineers, Patrick Air Force Base, Fla., spoke on "Construction at Cape Canaveral;" Sidney A. Berkowitz, assistant director, Bureau of Sanitary Engineering, Florida State Board of Health, on "Programs and Problems of the Sanitary Engineer;" and Ross H. Bryan, Nashville (Tenn.) consulting engineer, on "Prestressed Concrete in Multi-Story Construction." Mayor Robert S. Carr of Orlando welcomed the delegates and their wives at the evening dinner dance. Outgoing President Byron D. Spangler turned over the reins for the coming year to newly elected President Hozmer B. Wright. District 10 Director John D. Watson represented the National Headquarters at the convention.

There was a big turnout for the **Illinois Section** annual meeting, at which Life Membership Certificates were presented to twelve "loyal and perservering men . . . who have served the Society well over a period of 35 years." They are Lenox Riley Lohr, Ernest Edwin Michaels, G. Donald Kennedy, Herbert S. Grassman, George Otto Consoer, Robert A. Black, Hugh Donald Barnes, Robert Joseph Smith, Robert Horace Harrison, Payson Austin Perrin, and Leonard Chapin Childs. Another life member, Robert Wilmot Wallace, died last October. The "Chicago Engineer of the Year" award was then presented to Carl A. Metz, partner in Shaw, Metz and Associates. Among his many professional achievements are the design of the tallest light-weight reinforced concrete building in the world (36 stories); the Chicago Exposition Building; and air bases and port facilities in Spain. Retiring President Hendrickson introduced the new president, Robert L. Hall; the vice president, Paul H. Kaar; the treasurer, Jesse R. Anderson, Jr.; and directors, Robert H. DeGrange, Frank Klein and John F. Seidensticker, to the assemblage. A tremendous ovation was accorded the evening's principal speak-

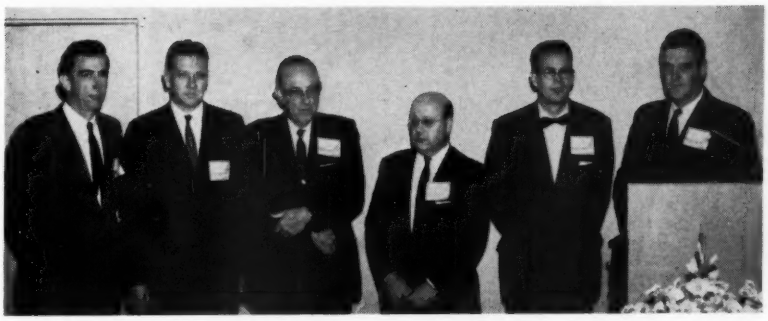
er, ASCE Vice President William J. Hedley, whose topic was "Portrait of An Engineer."

William N. Strobel was installed as president of the **Lehigh Valley Section** at the group's recent annual dinner meeting held in Allentown. Last year's second vice president, Jackson L. Durkee, automatically became first vice president; while Samuel Errera was elected second vice president and Carl H. Biers, Jr., secretary-treasurer. President Strobel, then, presented a certificate of appreciation to retiring president, Edward M. Cummings, and bestowed Life Membership Certificates on E. Leland Durkee, Arthur R. Graves and Linden V. Fisher, of the Bethlehem Steel Company; and Guy B. Walker, of the Wilkes-Barre municipal engineering office. Before the meeting adjourned Floyd S. Eckhardt, assistant to the vice president of Bethlehem Steel, told about progress in Russia in steel from observations made in that country with a 21-man delegation of iron and steel executives.

Guest speaker at a recent meeting of the **Maryland Section** was Paul L. Holland, former Vice President for Zone II who commented on the improvements resulting from the change in the membership grades of ASCE, the change in engineering education during the past several years, and "Unity" in the various engineering societies. Also on hand was the secretary-treasurer of the Maryland Port Authority, James W. Davis, who discussed the Baltimore Harbor channel dredging project.

At the January meeting of the **Jackson Branch of the Mid-South Section,** Dr. Charles E. Violet, test division leader for the Lawrence Radiation Laboratory at the University of California, discussed the Plowshare Program. This program has been sponsored by the Atmoic Energy Commission at the University since 1957. It is directed toward exploring the economic and scientific potentials of nuclear explosives, and according to Dr. Violet, may provide an efficient and inexpensive solution for large scale earthmoving.

The **Sacramento Section** presented four of its members with Life Membership Certificates. Those honored were Major General Ewart G. Plank (retired), Thomas B. Waddell, Anatol A. Eremin and Richard P. Bryan. In January Jack S. Barrish was installed as president; John L. Beaton, as first vice president; James J. Doody, as second vice president; Harold L. Joynes, as secretary; and L. Edwin Dunn, as treasurer.



The Tennessee Valley Section held its annual meeting in Chattanooga recently. Over 200 members and guests were present to hear Glenn Holcomb, ASCE President speak on Society affairs. Pictured with President Holcomb (third from left), are Chattanooga Branch President Benjamin O. Holmes; Tennessee Valley Section President Charles D. Durfee; Don H. Mattern, Vice President, Zone II; Marble J. Hensley, of the Mayor's office; and Gene Wilhoite, general chairman—all active participants in the two-day program.

Life Members were honored at a recent meeting of the **San Francisco Section,** which included among its guests National Directors Harmer Davis and Trent Dames and National Vice President L. A. Elsener. Present to receive Life Certificates were C. W. Appleford, F. E. Baxter, Jr., C. M. Colvin, R. G. Cone (since deceased), T. J. Corwin, Jr., A. Donaldson, E. C. Fortier, J. J. Gould, F. R. Hewes, H. R. Howells, J. W. Kelly, M. P. Kitchel, E. M. Knapik, H. L. Lyon, N. C. Raab, R. R. Randall, J. Skytte and J. G. Wright. New Life Members not present were P. L. Bech, E. L. Grant, J. R. McAuliffe and P. S. Wu.

The **Seattle Section,** in cooperation with the Puget Sound Engineering Council and the American Institute of Architects, recently sponsored a two-day "Civil Defense Workshop." The Office of Civil and Defense Mobilization also played an active part in the program which dealt with the design of radioactive fallout shelters.

The **Tennessee Valley Section** enjoyed another fine annual meeting recently as guests of the **Chattanooga Branch.** Every branch was represented among the 174 registered at the meeting. Speaking from his experiences of the past three years as a Director, Don Mattern, now Zone II Vice President, rated the Section as one of the most active in the Society. High praise also went to the University of Tennessee Student Chapter and its Contact Members Al Cooper and Jack Furgurson. At the luncheon honoring President Glenn W. Holcomb, the new head of the Society suggested that requiring top level work in mathematics and some other subjects, may be setting educational standards too high. For, he said, while space-age jobs may demand "genius types" there is still a large area of professional work for which practical men trained in the skill and art of engineering are needed. The technical program opened with discussion on the contribution of ASCE membership to the professional development of the engineer, followed by talks dealing with specific techniques. Myron O. Jensen was elected Section president, and Charles A. Sipe, Jr., vice president. At the evening banquet Life Membership citations were read for Poul L. Hornby, George K. Leonard, Jo C. Guild and R. E. Hardaway.

The **Dallas Branch** of the **Texas Section** at a recent luncheon meeting heard James D. Biddle, past president of Dallas Mortgage Bankers Association and director of the Dallas Real Estate Board, speak of the economics and techniques of financing commercial and industrial projects. Selection of new officers highlighted a recent meeting of the **Waco Branch.** Elected president was Albert L. Eberhardt, while Joseph W. Steede, Jr., was elected vice president and Ladis C. Motl, Jr., secretary-treasurer. Ralph W. Baird continues as director.

In a recent address before the Toledo Section Robert N. Linton (center), of the Toledo surveying firm of R. N. Linton Associates, used numerous old pieces to illustrate his talk on early American Surveying equipment. William Teaderman (left), member of the Toledo Section, and C. B. Patterson, Life Member of the Section, examine a 60-ft sliderule built in 1881 and a 111-year old sight compass (foreground) which aided in the establishment of boundaries for Hancock County in Ohio.

New officers of the Maine Section pose for a group picture with last year's president, Bryant P. Hopkins. From left to right are Edward C. Jordan, first vice president; John P. Hennings, secretary; Sylvester L. Poor, president; Bryant P. Hopkins; Frank M. Taylor, treasurer; and George K. Wadlin, second vice president.

Four of five new Life Members in the Pittsburgh Section received their Life Membership Certificates from ASCE President Glenn W. Holcomb at the Section's annual dinner meeting on January 10. Shown here, in usual order, are Donald L. Sommerville, Cornelio E. Portas, President Holcomb, Clarence D. Foight, and Edward J. Staubitz. The fifth recipient, Louis K. Whitcomb, was not present. The attendance of 113 included ASCE Director Earle T. Andrews and Vice President Donald H. Mattern. President Holcomb was featured speaker, with a talk on "Trends in Civil Engineering Education." Frank C. Sturges is new Section president.

LOCAL SECTION MEETINGS

Central Pennsylvania—Dinner meeting at the West Shore Country Club, Camp Hill, Pa., on March 16, at 6:00 p.m.

Georgia—Evening meeting sponsored by the Student Chapter of the Georgia Institute of Technology, Atlanta, Ga., on May 5.

Hawaii—Honolulu Post Convention Tour following the 1961 Phoenix Convention, April 20-21.

Los Angeles—Special general meeting on the campus of the University of California at Los Angeles, on May 10.

Metropolitan—Regular monthly meetings in the Engineering Societies Building on the third Wednesday of each month, at 7:00 p.m.

Mid-South—Annual Spring meeting in Vicksburg, Miss., April 27-29. Host for the occasion is the Vicksburg Branch.

Philadelphia—Joint meeting with the Society of American Military Engineers at the Engineers' Club, on April 11, at 7:30 p.m.; meeting of the Soil Mechanics and Foundations Division at the Engineers' Club, on March 17, at 7:30 p.m.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday, at 12 noon.

St. Louis—Regular monthly luncheon meetings at the York Hotel on the fourth Monday of each month, at 12:15 p.m.

Tennessee Valley—Annual spring meeting at the Hotel Sevier, Johnson City, Tenn., May 19-20.

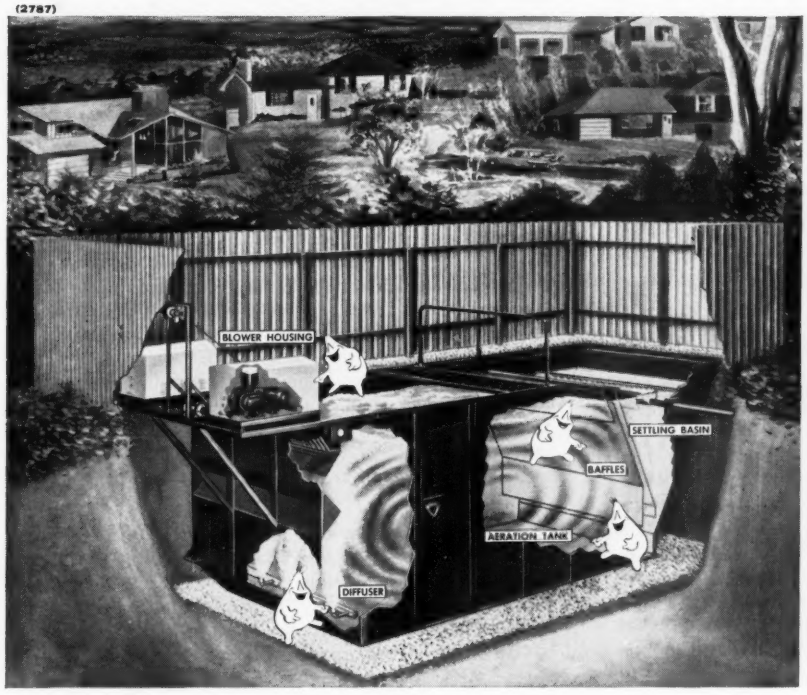
Texas—Annual spring meeting at the Roosevelt Hotel, Waco, April 20-22.

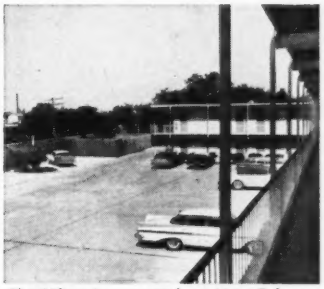
S&L Little Mike Microbe describes the Smith & Loveless "Oxigest" sewage treatment plant as "an ideal environment for the microscopic, living organisms in the sewage to consume or digest the suspended solids in the aeration tank and produce a stable, sparkling effluent."

Mike Microbe stars in a new Smith & Loveless movie which features the manufacture, operation and installation of an "Oxigest" sewage treatment plant.

To learn more about Mike Microbe—and how the Smith & Loveless "Oxigest" sewage treatment plant serves outlying subdivisions, motels, schools and factories — just write to Department 80 *Smith & Loveless*

(2787)




The Hilton Inn across from New Orleans International Airport is served by two 20,000-gallon "Oxigest" units.

A Kansas. City North subdivision is a good example of installations in parallel to serve a growing development.

Glen Oaks School in Baton Rouge, La., is a typical "Oxigest" installation to serve a school without sewers.

Camden, N. J., Latin Casino theatre and restaurant is provided sewage treatment by a large bolt-together "Oxigest."

A St. Joseph, Mo., mobile home park is served by a Smith & Loveless "Oxigest," with the new Alcoa aluminum fencing.

ONE OF THE UNION TANK CAR COMPANIES

P. O. BOX 8884/KANSAS CITY 15, MISSOURI
PLANT: LENEXA, KANSAS

BY-LINE WASHINGTON . . . . .

The new Administration has started its big legislative program. Already there have been bills on the minimum wage, stream pollution, social security changes; and Executive orders affecting highways and housing.

Note the difference, with the new Administration in the White House: The President himself announces the upcoming legislative moves, leaves no doubt of his backing of the bills themselves. Eisenhower was content to suggest, then leave it to legislative leaders to work out details.

For engineers, probably the most important piece of new legislation, as of mid-February, was Congressman Blatnik's proposed bill (HR 4036) on stream pollution control. More important than the big jump in money called for ($125 million yearly vs. the present $50 million) was a provision that would remove stream pollution activities from the control of the medically-dominated Public Health Service. Blatnik wants a separate Water Pollution Control Administration with its own Commissioner, reporting directly to the Secretary of Health, Education & Welfare. It would resolve a long-standing debate as to whether pollution is a medical or an engineering problem, and put strong enforcement powers into the hands of the new agency.

* * *

On the Executive side, President Kennedy has issued a stream of directives to pump money—but, importantly, money already available in most cases—into the economy via construction. The order to make available immediately the $724 million for federal-aid highways (which would not ordinarily have been put on until the fourth quarter of this year); the order to the Department of Agriculture to put $50 million into farm housing (which wouldn't have been available until after June 1); the speed-up by the Housing and Home Finance Agency in college housing and other projects—were all a part of this program.

* * *

Still to come, as of mid-February, was a summing-up of the new Administration's position on President Eisenhower's final budget, which had provided a total of about $7.9 billion for all government construction activities. It is significant to note that, in instructions to new agency heads, Budget Director David E. Bell said that "no change [in the Eisenhower budget] will be considered, unless the agency head feels very strongly that some modification is unavoidable." Upgrading in requests for military construction (which the outgoing President set at $1.3 billion) was expected.

* * *

There is plenty of new legislation to consider, and committee and other reports as well. On legislation, for instance, there is Senator Magnuson's re-introduction of a bill for a ten-year program of oceanographic research; a house bill (HR 2955) that would legalize "common-situs" picketing by construction labor unions; S. 722—the Republican counter to Democratic school-construction bills.

* * *

As to reports, the two most significant were the long-awaited "210" report of the Bureau of Public Roads concerning highway cost allocations, and the final report of the Senate Select Committee on National Water Resources.

The "210" report (made pursuant to Section 210 of the 1956 highway act) is a vast and detailed document which seems to steer a careful middle course on most controversial matters (such as allocating costs to the Defense Deparmtent), reaches some conclusions that were immediately attacked by special-interest groups: that trucks aren't paying their rightful share of highway costs; that navigational clearances required for highway bridges are adding several billion to the cost of the highway program; that the 1958 estimate of cost of completing the Interstate Program ($41 billion) remains unchanged; that federal reimbursement of states for cost of utility relocations has resulted in a "marked increase" in estimated costs (which is among the factors offsetting a 3 percent drop in roadbuilding costs).

The Select Committee report—climaxing nearly two years of investigations and the collection of mountains of never-before-assembled data—has been seriously misread in many quarters. Depending on how you add up figures included in the document, you can come up with "recommended" programs (over the next 20 years) ranging from $52 billion to $200 billion. The fact is that the individual figures shown overlap each other in many areas. Thus the $12 billion suggested program for construction of new dams and reservoirs, the $42 billion for new municipal and industrial sewage works, the $7.9 billion for Corps of Engineers projects in the same area, may very well each include elements of all three programs. Committee staffers pointed out that their main hope was to focus national attention on the general problem; present all the available facts and suggestions to Congress; bring the states into the picture early—rather than to set out a definite, year-by-year program of action.

* * *

Bookshelf items: "Airport Terminal Buildings," available, for 55 cents, from the U.S. Government Printing Office, was prepared by the Federal Aviation Agency as a guide to design of structures for cities with scheduled air carrier service, indicating methods of analysis of passenger traffic to forecast future volume; "Using Salt in Treating Clayey Soils for Winter Construction" (50 cents, Office of Technical Services, Business and Defense Services Administration, Department of Commerce) is a translation of a Russian civil engineering journal article on treating clayey soils for winter work, using water-soluble salts.

Goldendale School, Washington County, Wis. Architect: William P. Wenzler, Brookfield, Wis.

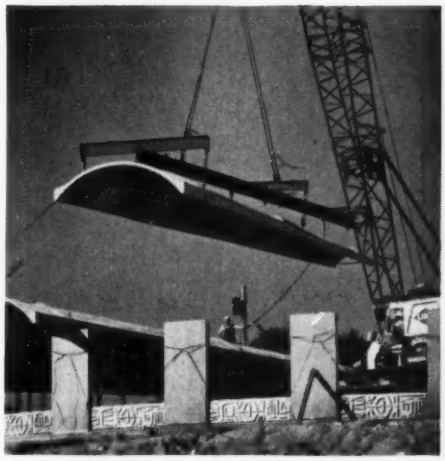
Circular-design school built entirely of concrete for less than $13.20 per square foot!

Near Germantown, Wisconsin, they've replaced the "little red schoolhouse" with a beautiful all-concrete structure of unique circular design. Housing three classrooms, this is the first unit of a projected 8-classroom primary school with auditorium-gymnasium.

The first unit was completed at a cost of less than $13.20 per sq. ft., including all service equipment for the full school. The completed building is expected to cost only $10.00 per square foot.

Concrete's inherent economies make modern design possible at reasonable cost. Thanks to precasting of shell roof elements, costs were reduced and construction speeded. Further economies resulted from the use of precast piers enhanced by the color and texture of exposed aggregate. Precast sculptured panels under the large windows added design interest at low cost. And interior walls are economical concrete block.

Once again, here's proof that where beauty, structural strength and fire-safety must be combined with economic realities—more and more architects and engineers turn to modern concrete construction. Write for free technical data on concrete shell roof design. (U.S. and Canada only.)



To effect circular design of building, precast concrete barrel roof shells are tapered. They are 57 ft. long, 12 ft. wide at one end, 5 ft. wide at other end. Shells are supported by precast piers.

FOR STRUCTURES... MODERN **concrete**

PORTLAND CEMENT ASSOCIATION

Dept. A3-13, 33 West Grand Avenue, Chicago 10, Ill.

A national organization to improve and extend the uses of concrete

News Briefs . . .

Road Researchers Urged to Look Ahead At Highway Research Board Meeting

Safe and efficient use of the nation's highways was the major concern of the 2,500 scientists, engineers, and public officials attending the 40th annual meeting of the Highway Research Board, held in Washington, D.C., January 9-13. Over 200 papers, geared to the general meeting theme of "The Look Ahead," reported results of the past year of research in highway financing, engineering, construction, planning, traffic control, and administration, and indicated areas in which improvement is especially needed.

At the opening general session Lawrence Hafstad, vice president of research for the General Motors Corporation, suggested graded licenses for automobile drivers, similar to airplane pilot licenses, as a safety measure. "At a price," he said "cars could be made, which would be more drunk-proof and crash-proof." He then asked, "How would the price of doing this compare with the cost of not licensing drunks and idiots? This would be the operations research approach to the problem."

According to Dr. Hafstad, highway research, to be effective, needs a "philosophy of transportation, with an agreed theoretical base, instead of the bits and pieces approach now largely being followed." In cities, he said, "the best solution to congestion and safety problems in traffic probably is the physical separation of pedestrians and vehicular traffic, a measure recommended by Leonardo da Vinci in the 15th century."

In the keynote address Pyke Johnson, chairman of the Highway Research Board, called for a greatly expanded program of research in social, economic, and legal problems facing highway transportation. Especially urgent, he said, are the complex issues in rapidly growing metropolitan areas. "The changing pattern of movement which the gasoline engine has brought with it challenges the present form of our local divisions of government," he declared.

One new research project recently approved by the Highway Research Board, he reported, is a full investigation of the problem of de-icing of bridge structures. "Little understood as yet by the driving public, but of deep concern to highway builders, is the problem of rapid accumulation of ice on bridges. . . . These structures quickly become points of hazard to motorists in times of cold weather. To protect him, various materials are used which melt the ice but which tend to corrode the bridge." Mr. Johnson added that it may take years to correct this fault but that when it is corrected "many millions will be saved in construction and maintenance costs."

The need for more attention to planing was stressed in many talks. W. L. Haas, of Highway Management Associates, Madison, Wis., told an audience of highway administrators that better long-range planning will assure public understanding and support of highway programs. Emphasizing the need for top-echelon treatment of the planning function in state highway departments, Mr. Haas said, "In earlier years, most highway planning was necessarily improvised, hastily prepared, and often done without adequate study and facts upon which sound decisions could be based. This condition provoked much public criticism and probably accounts for some of the current concern about the highway programs." In contrast with those earlier years, he added, a recent survey showed that in 35 states the planning unit has been given major division status.

William A. Bugge

Head-on conflicts between urban expressway projects and urban redevelopment programs can be avoided through proper coordination between state highway planners and local planning commissions. This was the gist of a talk given by Robert F. Van Hoef, director of the Planning Division of the Michigan State Highway Department. Mr. Van Hoef described procedures worked out in Michigan to coordinate highway programs and land-use planning. Basically, this involved mutual agreement between local community planners and highway department planners on a system of highways. Further, there is agreement that the proposed system is compatible and consistent with existing and proposed development projects and capital improvement programs of the community.

Comparatively simple traffic engineering techniques can vastly improve the traffic-carrying capacity of urban arterial streets, Edmund A. Hodgkins, A.M. ASCE, highway engineer for the U.S. Bureau of Public Roads, reported. Mr. Hodgkins based his report on traffic studies on Wisconsin Avenue in Washington, D.C., made before and after the removal of street cars and loading platforms, imposition of parking restrictions, and changes in signal timing.

Among the results were: (1) Traffic volume increases of up to 47 percent; a 7 percent increase in average speed; and (3) peak-hour reduction of 86 percent in the number of stops required to drive the length of the avenue.

William Bugge elected chairman

William A. Bugge, F. ASCE, director of the Washington State Highway Department, was elected 1961 chairman of the Highway Research Board during the meeting. In addition, he was also chosen to receive the Bartlett Award, the highest honor in the highway field. Mr. Bugge, a 40-year veteran in the highway engineering field, is chairman of the ASCE Highway Division and vice president of the American Road Builders Association.

Robert R. Liteheiser, F. ASCE, engineer of tests for the Ohio Department of Highways, and Harold Allen, F. ASCE, chief of the Division of Physical Research, U.S. Bureau of Public Roads, received the annual Roy W. Crum Award for distinguished service in highway research at the 40th anniversary banquet. The award is a memorial to Roy W. Crum, F. ASCE, for many years director of the Highway Research Board. Kenneth A. Stonex, assistant director of the General Motors Proving Ground, received the annual Highway Research Board Award for a technical paper of outstanding merit.

Construction Spending Declines in January

Expenditures for new construction, put in place in January, came to $3.8 billion —a decline of 15 percent from December 1960—according to preliminary estimates of the Bureau of the Census of the U.S. Department of Commerce. The normal December-January decline is about 13 percent. However, spending for new construction this January was about the same as in the comparable month a year ago.

Outlays for private construction this January amounted to $2.8 billion, down 12 percent from December and 4 percent under the January 1960 level. The nor-

mal seasonal decline would have been about 11 percent. Of private construction outlays, $1.4 billion went for nonfarm housing. This amount represented a 16 percent drop from December and was 12 percent below the January 1960 level.

Public construction expenditures this January totaled $1.1 billion—20 percent less than in December but 15 percent more than in January 1960. The normal December-January drop in public spending is about 17 percent.

Delaware River Basin Compact Is Approved

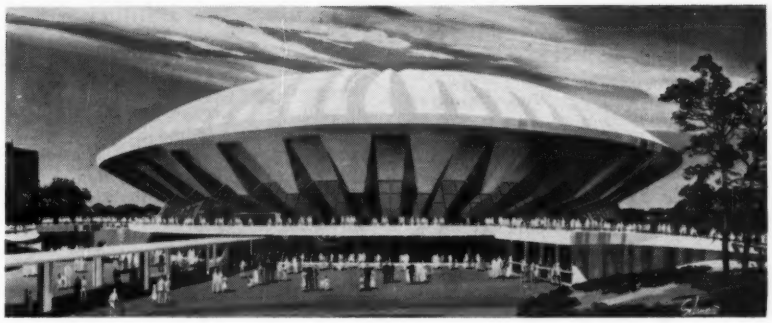
Governors of four states and the mayors of New York and Philadelphia met in Philadelphia on February 1 to approve a compact establishing a Delaware River Basin Commission. The four states represented in the compact, which would assume responsibility for development and control of the water resources of the 12,750 sq miles drained by the Delaware and its tributaries, are New York, New Jersey, Pennsylvania, and Delaware. The Federal Government will be a fifth party to the treaty, which must be approved by Congress as well as by the four state legislatures.

If approved, the plan would entail a capital outlay of $500,000,000 over a 50-year period. Annual expenses are estimated at between $500,000 and $1,000,000. Capital funds would be obtained from bonds, and running expenses from funds appropriated by the five parties to the treaty according to their respective interests. At the present time the Federal share is estimated at about 50 percent.

The plan was drafted by the Delaware River Basin Advisory Committee—a group set up by the four governors and the two mayors following the disastrous Delaware River floods of August 1955. Its objective is stated to be ". . . planning, conservation, utilization, development, management, and control of the water and related natural resources of the Delaware River Basin, for the improvement of navigation, reduction of flood damage, regulation of water quality, control of pollution, and development of water supply, hydroelectric energy, fish and wildlife habitat and public recreational facilities."

The commission would work with existing agencies at all levels of government, and would be empowered to construct dams and other facilities required to carry out its objectives. The section providing for the generation of hydroelectric power specifies that power so generated may be marketed on a wholesale basis but not sold directly to consumers. This would eliminate any possibility of a Middle Atlantic TVA.

Proposed projects include a power dam north of Delaware Water Gap, which would form the largest fresh-water lake on the Atlantic seaboard.



Circular Prestressed Concrete Beam to Support Stadium Dome

Tradition-breaking indoor stadium, consisting essentially of an inverted truncated cone covered by a dome, will be completed on the University of Illinois campus next year. The dome will be entirely supported by a 400-ft-dia post-tensioned concrete beam integral with the upper edge of the truncated cone. The outer circumference of the beam will be wrapped with 600 miles of prestressing wire to enable it to carry the dome. A 36-ft-wide deck, enclosed in glass, will circumscribe the outside perimeter of the concrete cone about 12 ft from the ground. Spectators will enter the stadium at this level, as well as through ground level approaches. Cost will be approximately $7,750,000. The architects are Harrison & Abramovitz, of New York; the structural engineers Ammann & Whitney, of New York; and the general contractor, the Felmley-Dickerson Co., of Urbana, Ill. Prestressing is by the Preload Co., Inc., of New York.

Insurance Building Features 12-Story Elliptical Tower

Fourteen-story home office building for the Phoenix Mutual Life Insurance Company, to be built in Hartford, Conn., will feature a 12-story elliptical tower, first of its type in the world. Scheduled for completion in 1963, the building will be a dominant structure in Hartford's 12-acre, $40,000,000 Constitution Plaza redevelopment of a blighted downtown area. The elliptical design of the tower will permit quick access to all offices from elevator and service areas. The unusual design also reduces surface area of the tower, contributing to economical construction. Harrison and Abramovitz, of New York, are the designers.

AWWA Nominates Officers for 1961

The American Water Works Association has nominated new officers for its 1961-1962 year. The nominations were made by the AWWA board of directors at a recent meeting in New York City.

John W. Cramer, F. ASCE, senior partner in the Lincoln, Nebr., consulting engineering firm of Fulton & Cramer, is the nominee for president. Active in the AWWA since 1948, Mr. Cramer has held a number of offices in its Water Resources Division and is now completing a year as vice president. In 1954 he received the Association's George Warren Fuller Award for outstanding service in the field of public water supply.

John W. Cramer

Other nominees are William J. Orchard, of Maplewood, N. J., who has been nominated for a fifth term as treasurer, and William D. Hurst, city engineer and chairman of commissioners of the Greater Winnipeg (Manitoba) Water and Sanitary Districts, nominated for vice president.

The new slate will be inducted at the close of the Association's annual meeting, to be held in Detroit, Mich., the week of June 8.

Computers for Sanitary Engineering Education

The Cornell University School of Civil Engineering is setting up a program that will make first full use of systems engineering methods and computer technology in sanitary engineering education. The program will be carried out under the terms of a five-year U.S. Public Health Service grant of $172,000 to the Sanitary Engineering Department. By use of systems engineering and computers, it will be possible to solve many of the complex water supply and waste disposal problems perplexing the nation quickly and at relatively low cost.

Systems engineering—a method of analyzing and finding the most effective design and operation for complex systems as a whole—is already being used to solve complicated industrial and military problems. The application of the systems engineering concept to sanitary engineering systems will depend on taped, or card-imprinted, data stored in the computer's so-called "memory." Entire water supply and waste disposal systems will be represented by symbols and numbers. These taped plants and facilities will be fed problems, also translated into symbols and numbers. However, before simulation techniques can be refined to the point where they are useful to sanitary engineers, the entire concept of teaching sanitary engineering must be altered to take advantage of the field's new tool—computer programmed systems analysis.

According to Prof. Charles D Gates, who will be in charge of the project, the program will meet the need for some means of integrating the vast body of research results available into meaningful information that can be used in engineering practice.

Iron and Steel Plants In Thirty-five States

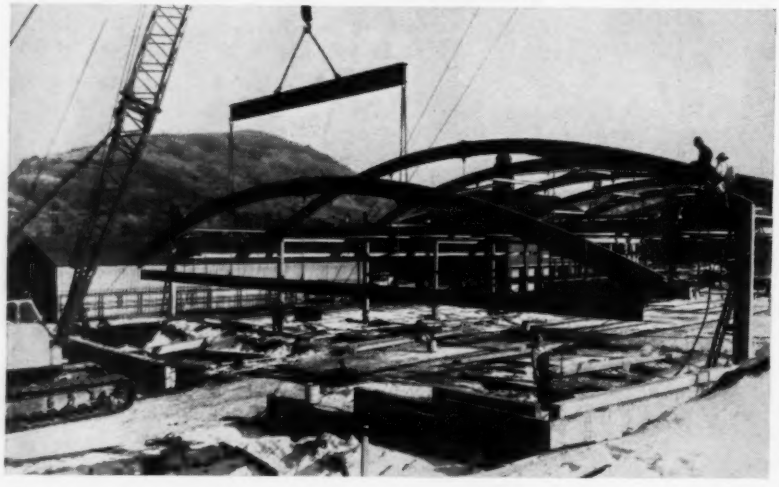
The iron and steel industry in the United States now consists of over 275 companies with plants located in 300 communities in 35 states, according to the American Iron and Steel Institute. About 85 of the companies make the raw steel required to produce finished products. Most of the others are engaged in further rolling and drawing semi-finished steel obtained from steel ingot producers. Still others produce pig iron.

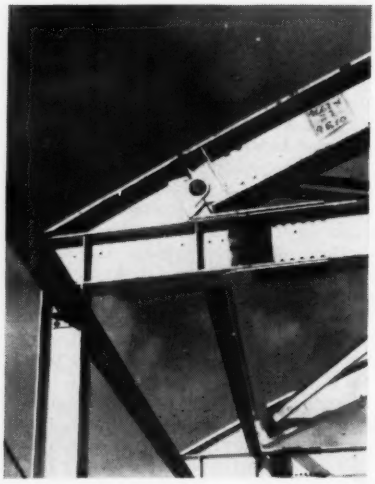
Twenty or more different types of major finished steel mill products are made in six of the big steel-producing states—Pennsylvania, Indiana, Illinois, Ohio, California and New York.

With steel companies competing for growing markets, the iron and steel industry has expanded in most states in the postwar era. Competition within the industry is keen. For example, about 75 companies manufacture tubular products; more than 55 compete in wire and wire products; and about 37 make concrete reinforcing bars.

Tied Arches Form Unique Roof Support for Storage Structure

Seven tied arches, with ribs exposed, support roof section of 97- by 300-ft structure which the Pennsylvania Electric Company is erecting in Johnstown, Pa., for storage of materials and line equipment. Ribs of the tied-arch roof supports rise to 13 ft from the chord at centers, the arches spanning 97 ft. Chords, or "ties," consist of 18-in. H-sections varying in weight from 55 to 85 lb per ft. Each arch has five perpendicular hangers, 1¾ to 2½ in. in dia, attached to the ribs and ties with adjustable clevises and spaced 16 ft 2⅜ in. apart on centers. Photo at left shows tied-arch truss being raised into position. Truss connection, showing high-strength bolting, welding, and pin connector, is detailed at right. Another unusual feature of the one-story structure will be the use of heavy, 14-in. wide-flange center columns with shop-welded stubs at the four floor intersections to take the floor framing. Bethlehem Steel Co. fabricated and erected the unique roof supports.





Western Engineers Receive Beaver Awards

Four Western engineers prominent in the heavy construction industry were honored at the Beavers' Sixth Annual Awards Banquet held in Los Angeles on January 19.

Recipients of the coveted trophies, which recognize "outstanding careers" in the construction field, were John L. Savage, Hon. M. ASCE, retired consulting engineer of Denver, cited for "special honors"; George T. McCoy, F. ASCE, retired California State Highway Engineer, for "engineering achievement"; T. E. Connolly, head of the San Francisco contracting firm bearing his name, for "distinguished management"; and David E. Root, retired vice president of Guy F. Atkinson Company, for "achievement in supervision."

As designing engineer for the U.S. Bureau of Reclamation for many years, Mr. Savage is responsible for some of the West's most notable dams—Parker, Imperial, Hoover, Davis, Shasta, to mention a few. Since his retirement from the Bureau he has been consultant to foreign governments on engineering projects all over the world. As chief of the California Division of Highways for sixteen years, Mr. McCoy is credited with having revolutionized the state highway system. At the time of his retirement in 1959, the state had 2,300 miles of multi-lane divided highway representing an investment of $2½ billion.

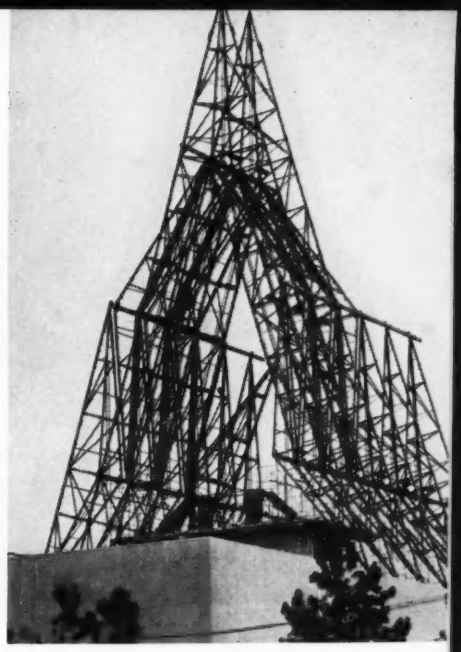
Combined School and Office Building Planned

The possibility of building a combination commercial high school and skyscraper office building on city-owned property in mid-Manhattan is under consideration by the New York City Board of Education. The city would provide approximately one-third of the estimated construction cost of $15,000,000, and the remaining share, for the commercial part of the structure, is expected to come from private sources. The city believes that income from the commercial part of the structure would more than defray the cost of the school.

Preliminary plans call for a 41-story building, with the school occupying the first eight floors and commercial interests the rest of the building. Students and office workers would not come in contact with each other, as there would be separate entrances and lobbies for each. The building would be set back from the sidewalk and surrounded on three sides by a plaza. A site for the proposed building has been selected but not announced.

The use of other types of dual-purpose buildings is being studied by a special school group, headed by Dr. Herbert A. Landry, director of the Bureau of Educational Program Research and Statistics. The study is being supported in part by a $75,000 grant from the Ford Foundation.

Steel Pipe Supports Form Air Force Chapel



One hundred tetrahedral-shaped supports made of steel pipe form the many-spired chapel being erected at the U.S. Air Force Academy at Colorado Springs. The 75-ft-long tetrahedrons are fabricated from Republic Steel's 4- and 6-in.-dia steel pipe. Unlike more conventional structural forms that can be put together from I-shaped or H-shaped beams, the tetrahedrons call for fabrication of complicated miter joints. The use of pipe facilitates the handling of the unusual precision joints. The pipes were cut to proper length and welded into shape with the aid of special welding patterns for the torches and special jigs for holding and turning the pieces during assembly. The architect is Skidmore, Owings & Merrill, and the contractor the Mississippi Valley Structural Steel Co.

Mont Blanc Tunnel—Second Anniversary

This January marked the second anniversary of the start of work on Mont Blanc Tunnel, connecting France and Italy under the Alps. The seven-mile tunnel will be the longest vehicular tube in the world, as well as the first all-year, all-weather crossing of the Alps. When it is finished it will cut driving time between Paris and Milan by several hours.

In the past two years work on the Italian side of the project has advanced 8,250 ft. However, many difficulties have hindered the project. Several times work has been halted by water pouring into the tunnel from the rock face and flooding the heading. Unstable rock conditions have necessitated changing from full face to the top heading method of tunneling, and at one stage because of extremely soft rock conditions the normal drill-and-blast method had to be abandoned in favor of the pick and shovel.

A special hazard was posed by "rock bursts," occurring in the form of sudden explosions caused by the rapid decompression of the rock following the opening of the 925-sq ft tunnel area. The bursts are most common in brittle rock, and result from the tremendous pressures being exerted on the excavated section. Pressure was estimated at 3,550 psi. To halt the bursts, Italian contractors resorted to bolting lengths of steel netting to the roof with expansion bolts.

When the tunnel reached 6,890 ft, the danger from rock bursts had increased to such an extent that still another method of advance was tried. This system involved driving a pilot tunnel having an area of approximately 161 sq ft. Excavation of the remaining 767 sq ft was carried out simultaneously with the excavation of the pilot tunnel, but at a distance of 33 ft behind. This method was adopted in an effort to reduce the rock stresses in the tunnel face. The pilot tunnel also served to explore the nature of the rock lying ahead as the tunnel advanced deeper into the mountain.

Extreme flexibility of the drilling system permitted the frequent changes in the method of advance. The miners, working from the decks of a drilling platform of simple design, use lightweight but powerful high-speed drills mounted on pneumatic pusher legs. Drilling equipment is supplied by Atlas Copco.

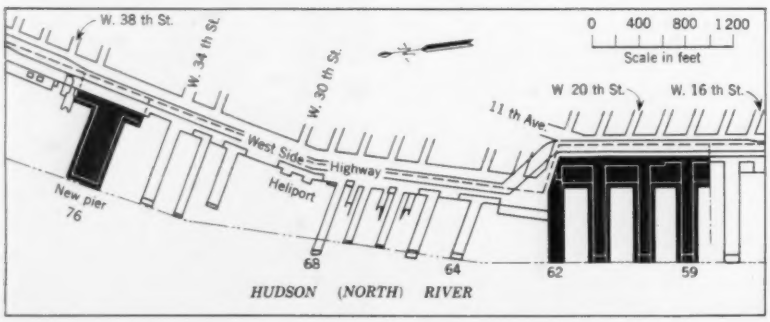
Hundreds of holes have to be drilled in the tunnel roof for the 7-ft-long expansion bolts that hold the protective steel netting in place. This safety precaution is taken to protect miners from rock bursts, which cause masses of rock to explode from the roof of the tunnel.

Unusual Steel Construction Speeds Work on Student Building

Construction of the new Student Union Building at Illinois Institute of Technology, Chicago, will be completed shortly. Supporting girders of the curtain-wall structure are shown in position. The girders are 160 ft long by 5 ft 3 in. in depth, and each is supported by only two concrete columns, which rest on caissons. The tapered columns, set 32 ft in from the outside wall, support the cantilevered girders. The massive steel girders—fabricated by Vierling Steel Works, Chicago, and shipped to the job site in three sections—were then welded into one unit and positioned on the columns. The ease of this method of construction is said to have resulted in a large saving in time and construction cost. Skidmore-Owings & Merrill are the architect-engineer, and Power Construction, Inc., the general contractor.

New York City to Redevelop Chelsea Pier Area

Under the terms of a 20-year lease just signed by the United States Lines with the New York Department of Marine and Aviation, the Department will undertake the development of two major North River waterfront facilities providing nine freighter berths. The $25,000,000 project includes redevelopment of the city-owned Chelsea Piers, now tenanted by the line, and construction of a new two-berth freighter terminal at the foot of West 35th to 37th Streets. The location plan for redevelopment of the Chelsea Pier area is shown here. Facilities to be developed will be the most extensive and costly yet undertaken in the Department's five-year $200,000,000 waterfront rebuilding program. Preliminary plans were developed by the Roberts & Schaefer Company, consulting engineers, in collaboration with Rear Admiral Roy T. Cowdrey, USN (ret.), consulting engineer for the Department of Marine and Aviation, and Albert F. Bauer, director of port planning and development for the department.



More Electricity for Southern California

A construction budget of $131 million has been announced by the Southern California Edison Company for 1961—the sixth consecutive year that the company's plant outlays have exceeded $100 million. During the past ten years Edison has spent more than $1 billion in additions and improvements to its electrical system serving Central and Southern California. The 1961 boost to Southern California economy will include huge new generating plants, electrical substations, offices, and about 950 line miles of power circuits.

Among the current projects are the world's first computer-automated generating units, being built at the Huntington Beach Steam Station. At Alamitos Steam Station, near Long Beach, work is progressing on two units that will nearly triple the generating capacity of the present plant. The new units, each rated at 310,000 kw, will cost about $78 million and are scheduled for completion next year. Nine new distribution substations are slated for construction this year.

Trans-Canada Highway Nears Completion

One of the final sections in the 4,800-mile Trans-Canada Highway has been opened with completion of a 165-mile stretch in the province of Ontario. The new section, which completes the highway through Ontario, extends from the Agawa River, 95 miles north of Sault Ste. Marie, to Marathon in a densely forested area. Most of the route provides views of Lake Superior and many smaller bodies of water.

The longest national highway in the world, the Trans-Canada Highway crosses the Dominion from Nova Scotia to British Columbia. Except for a 90-mile gap in British Columbia, the entire length of the scenic highway is now open to traffic. A joint project of the federal government and provinces, it has so far cost over $616 million.

Watershed Congress To Be Held in Tucson

ASCE members attending the Phoenix Convention, April 10-14, may want to remain in the Southwest a few extra days to attend the Eighth National Watershed Congress, conveniently slated for April 17-19. The Ramada Inn in Tucson will be congress headquarters. The congress, which has the aim of expediting and broadening local watershed programs, is sponsored by twenty-seven of the nation's leading agricultural, industrial, business, and conservation groups. The overall theme is "Count-Down on Water."

The Hon. Robert S. Kerr, U.S. Senator from Oklahoma, heads the long list of distinguished speakers that includes some

of the country's best known conservationists. There will be luncheon meetings all three days, and the annual dinner on April 18. Arrangements have been made with the Agricultural Research Service for a post-congress field trip to the 65-sq mile Walnut Gulch Watershed at Tombstone on April 20.

Inquiries about the congress should be addressed to the Watershed Congress Housing Bureau, c/o Tucson Convention Bureau, P.O. Box 991, Tucson, Ariz.

ASA Standard on Metallizing Symbols

The expanded use of metallizing for both new fabrication and repair work points up the need for a uniform method of conveying specifications from the design office to the shop. To facilitate placing the required metallizing information on drawings, the American Institute of Electrical Engineers and the American Society of Mechanical Engineers, in collaboration with the American Welding Society's Committee on Metallizing, have sponsored issuance of *Standard Metallizing Symbols*. The American Standards Association has approved the reference, which is identified as ASA Y32.12-1960.

Inquiries about the Standard should be sent to ASA Sectional Committee Y32, c/o the American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y.

Westinghouse Corporation Celebrates 75th Birthday

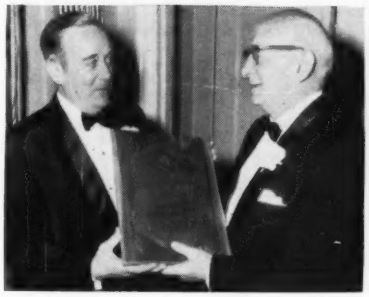
This January the Westinghouse Electric Corporation celebrated its diamond anniversary. Founded seventy-five years ago with a charter, authorizing a young Pittsburgh engineer to begin the manufacture of electrical equipment, the corporation has become one of the country's best known makers of consumer products as well as one of the world's leading manufacturers of electrical apparatus.

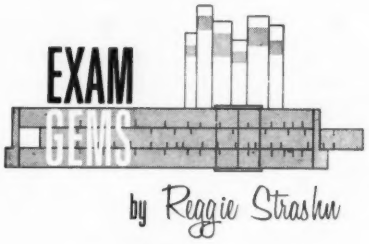
George Westinghouse began the company known today as the Westinghouse Electric Corporation with a leased building in downtown Pittsburgh, and 200 employees. The inventive young engineer founded his company primarily on the strength of one advanced product—the newly invented transformer which made possible the widespread use of alternating current. Today Westinghouse makes some 300,000 variations of 8,000 products at over 100 plants throughout the United States. It has 112,000 employees and sales are at an annual rate of more than $1,900,000,000.

During this anniversary year the company's greatly expanded research and development center near Pittsburgh will be completed. Its research and engineering program utilizes the services of 8,000 engineers and scientists and costs about $190,000,000 annually.

Moles Award for ASCE Member

Harry T. Immerman, F. ASCE (right), receives the 1961 Moles Award for eminence in the heavy construction field from George F. Flay, Jr., F. ASCE, of the Stock Construction Corp. Mr. Immerman, vice president of The Moles and vice president and chief engineer of Spencer, White & Prentis, was cited "in recognition of accomplishments spanning half a century, and for his many contributions to our nation's welfare." Herman Brown, founder and president of Brown & Root, Inc., of Houston, Tex., is this year's non-member award winner.





R. ROBINSON ROWE, F. ASCE

With a forebay-penstock-turbine-draft tube-afterbay sequence, EXAMGEM No. 20 laid such emphasis on certain hydraulic principles that entrance, friction and outfall losses had been purposely zeroed, leaving a fully conservative system. There being no other dissipation of energy, all was transmitted to the turbine, in the amount of

$$P = \frac{QH}{8.8} = \frac{3.44}{8.8} = 15\ h_p$$

Computing pressures at A in the penstock and B in the draft tube was nearly as simple for those who had mastered the Bernoulli equation. They can skip what follows.

The problem was given in May 1943, at the end of a 7-month seminar conducted by Reggie and largely attended by highway engineers who couldn't tell Bernoulli from Camembert. However, they lived on profiles, so Reggie urged them to diagram all flow problems, translating the data to profiles of invert, water surface, hydraulic grade and energy grade.

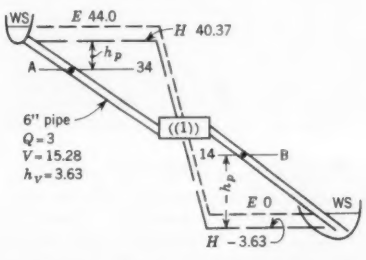


Fig. 1. With a profile view, energy grade E and hydraulic grade H clarify pressure heads h_p at A and B.

The stratagem backfired when the sketch accompanying this problem placed all elements on the same abscissa without any longitudinal extent.

Fortunately most of the highway engineers visualized the sketch as an end elevation. Using vivid imaginations, they supplied longitudinal extent, as shown in Fig. 1, the scale being immaterial because of the frictionless pipe.

There being no entrance or friction loss, energy grade was 44.0 thruout the penstock. There being no friction in the draft tube and full recovery at the afterbay, energy grade was 0.0 thruout the draft tube.

The hydraulic grade is the energy grade less the velocity head, which was constant at 3.63 ft for the discharge of 3 cfs thru a 6-in. pipe at 15.28 fps. These were diagrammed as level lines at Els. 40.37 and − 3.63 respectively.

Now at Point A at El. 34 in the penstock, the pressure head is its distance below the hydraulic grade, or 40.37 − 34 = 6.37 ft. For each foot of head the pressure is the unit weight of water, 62.424 psf, or 62.424/144 = 0.4335 psi. Hence

$$p_A = 6.37 \times 0.4335 = 2.76 \text{ psi}$$

Point B in the draft tube is *above* the hydraulic grade, so signs will be negative and pressure will be "vacuum." The pressure head is − 3.63 − 14.0 = − 17.63, so that

$$p_B = -17.63 \times 0.4335 = -7.64 \text{ psi}$$

California classed this problem as a gem by repeating it several years later, but the answers proved that it must have been worked over in every seminar. However, it's good enough to run again with some disguise, like head losses here and there and vacuum heads over 34 ft. The next problem, for example, has been used on two other occasions with innocent-looking changes that materially affect the solution.

EXAMGEM No. 21

A watertight box 6 ft square and 10 ft deep contains impervious particles whose bulk weight is 40 lb per cu ft, with a ratio of voids of 30 percent and standing to a depth of 3 ft. If the box is filled with water until the water is 5 ft deep, what is the pressure in lb per sq ft on the bottom of the box?

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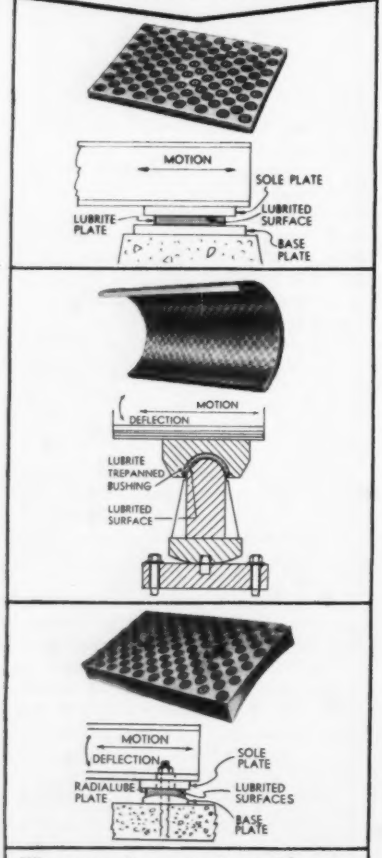

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DECEASED

Former ASCE Director Carl Paulsen, Dies

Carl G. Paulsen (M. '27; F. '59), age 73, former chief hydraulic engineer of the U.S. Geological Survey, died recently in Caldwell, Idaho.

He served from 1911 to 1914 as a hydrographer of the U.S. Bureau of Reclamation. Then he joined the Geological Survey, where he served successively as district engineer of the Idaho district, as chief of the Surface Water Branch in Washington, D.C., as assistant chief hyraulic engineer and, from 1946 until his retirement in 1957, as chief hydraulic engineer. He was a member of the three-man commission, appointed by the United Nations, which was charged with planning the development of the mighty Mekong River between Laos, Thailand, and Cambodia. For his outstanding service during a long career the Department of the Interior in 1957 awarded him its highest honor, the Distinguished Service Medal. Mr. Paulsen was Director of ASCE for the 1953-1955 term.

William Henry Adams (M. '20; F. '59), age 82, since 1955 senior structural engineer of the Detroit, Mich., firm of Harley, Ellington & Day, Inc. Mr. Adams had previously served for thirteen years as a research engineer with the Great Lakes Steel Corporation.

Samuel R. Albert (M. '50; F. '59), age 61, from 1936 until his recent death was with the U.S. Bureau of Public Roads as a bridge engineer. During this period, Mr. Albert served on the Alaska Highway, the Inter-American Highway in Costa Rica, the Cochabama-Santa Cruz Highway in Bolivia, and for the last two years was on assignment in Jordan and Liberia.

David Robinson Allmond, Jr. (A.M. '32; M. '59), aged 61, in recent years was with Hawaiian Bitumuls and Paving Company, Ltd., and Craig Company, Ltd., of Honolulu. Mr. Allmond's specialties were airport and road construction and it was in these areas that he served the Illinois State Highway Commission and the Standard Oil Company of California prior to 1940.

Leigh B. Barrett (M. '56; F. '59), age 61, chief of the Contract Support Division, Military Construction Corps of Engineers, in Washington, D.C., had been employed in the division since 1946.

Joseph S. Bright (M. '17; F. '59), age 82, during his 32 years with the U.S. Bureau of Public Roads served it as deputy commissioner and as district engineer in charge of civilian forces building the Alaska Highway in World War II. When he retired from the Bureau in 1949, Mr. Bright opened a consulting office in San Bernadino, Calif., which he maintained until four years ago.

John B. Coleman (M. '29; F. '59), age 81, for 53 years was chief engineer for the Grinnell Corporation of Providence, R. I. While with the Grinnell organization, Mr. Coleman specialized in sprinkler systems and methods of extinguishing fires. Numerous of his articles have appeared in technical publications.

Russell Cone (M. '34; F. '59), age 64, who was resident engineer on and later in charge of maintaining the Golden Gate Bridge in California, died recently in Vallejo, Calif. Mr. Cone was a vice president of Mason & Hanger-Silas Mason. He served on the board of inquiry investigating the collapse of the Tacoma Narrows bridge; and as recently as 1956 was manager in charge of the contract for construction of foundations for the new Carquinez Bridge.

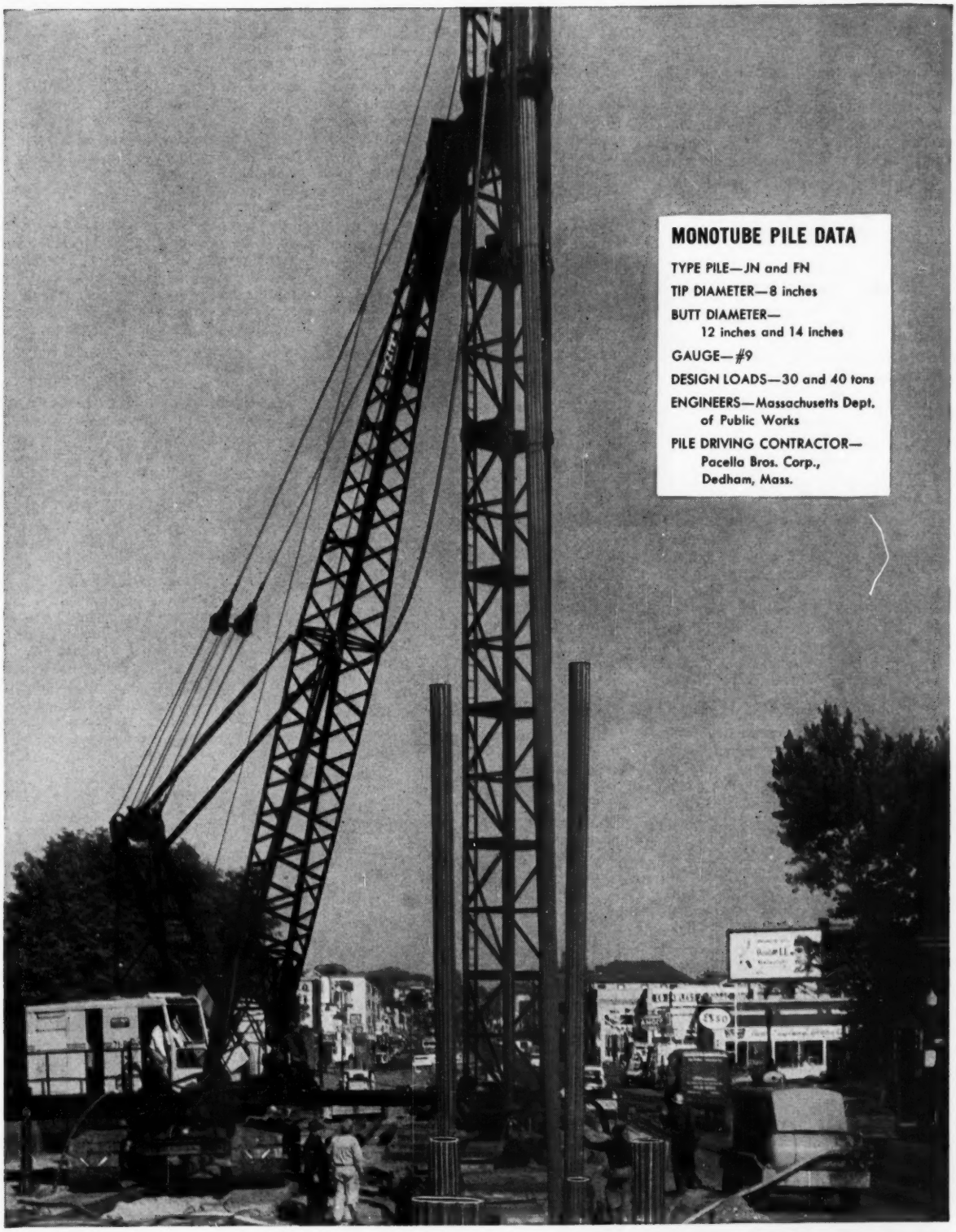
Charles Brown Cornell (M. '27; F. '59), age 80, after a career which predated the 1920's, retired as senior city water engineer for Columbus, Ohio, in 1957. During this extended period he was construction engineer for O'Shaughnessy Dam; engaged in preliminary work for Hoover Dam; was in chagre of construction of the Pretty Boy Dam and Reservoir and the Savage River Dam and Reservoir.

Foster B. Crocker (M. '36; F. '59), age 76, retired associate engineer for the New York State Department of Public Works at the Syracuse district engineer's office, died in Fayetteville, N.Y., on December 4. At the time of his retirement in 1950, Mr. Crocker had been with the Department of Public Works for 45 years. He was one of the state's foremost waterways engineer.

Walter N. Frickstad (M. '20; F. '59), age 81, who gave more than 40 years of professional service to the inhabitants of California, served as senior highway engineer with the U.S. Bureau of Public Roads at the San Francisco regional office for most of 1919 to 1930. In the latter year he became city engineer and superintendent of streets for the City of Oakland (Calif.), remaining there until 1949. Co-author of several books and a frequent contributor to Transactions, Mr. Frickstad in 1955 had published "A Century of California Post Offices."

Harold K. Gatley (M. '30; F. '59), age 69, since 1938 consulting engineer for the City of Bridgeport, Conn. In addition to his consulting office in Bridgeport, Mr.

(Continued on page 90)



FAST-DRIVING MONOTUBE PILES PERMIT NORMAL TRAFFIC FLOW along side this 96″ diameter storm sewer project in Worcester, Mass. Easy handling and rapid installation using light, mobile equipment make Monotube foundation piles ideal for this type of project.

Tapered, fluted Monotube piles are available in lengths, diameters and gauges to meet every requirement. The Union Metal Manufacturing Co., Canton 5, Ohio — Brampton, Ont., Canada.

UNION METAL

Monotube Foundation Piles

Gatley maintained an office in Millburn, N.J.

John J. Gould (M. '42; F. '59), age 62, structural engineer for many projects in San Francisco, served as senior structural engineer of the California state division of architecture, from 1933 to 1935, and was chief of the structural engineering division of the San Francisco World's Fair in 1935. Mr. Gould, who had been in private practice since 1940, formed a partnership with H. J. Degenkolb in 1956.

Ray Ewall Hill (M. '55; F. '59), age 60, began his Federal career in 1929 when he joined the Corps of Engineers at Memphis, Tenn., as a senior draftsman. At the time of his death, he was serving as director of the construction division in the Public Works Office of the Fourteenth Naval District at Pearl Harbor, and as such had responsibility for the construction of all major Naval shore facilities in the district.

Clarence D. Howe (M. '17; F. '59), age 74, the first professional engineer ever named to the Canadian Cabinet, headed the Ministry of Railways and Canals and Ministry of Marine—which he combined into the Ministry of Transport—in the 1930's. Later, as wartime Minister of Production, he expanded the country's infant industry into a potent production force. He re-organized the government-owned Canadian National Railways, built the country's national airline (Trans-Canada) into one of the top international airlines, set up the Canadian Broadcasting System, and established the National Harbours Board. Included among his many honors was the 1952 Hoover Medal.

William P. Irvin (A.M. '40; M. '59), age 80, consulting engineer and inspecting engineer for the Federal Government. Mr. Irvin, who early in his career served as an assistant engineer for the construction of Washington's Union Station, had been a partner in the real estate firm of Irvin and Shenk.

Sterling Johnston (M. '30), age 82, retired bridge erection and structural engineer. While assistant general manager of the Canadian Bridge Company, he participated in planning the erection procedures used in the final successful lift of the previously ill-fated center span of the Quebec Bridge. Later, he worked on the erection procedures used in the towers of the George Washington Bridge and was similarly employed on the towers for the Golden Gate Bridge for the McClintic Marshall Corporation and its successor, the Bethlehem Fabricated Steel Construction Company.

Louis R. Kessler (A.M. '47; M. '59), age 51, operations vice president of the Owens-Corning Fiberglass Corporation and for a number of years general manager of its Pacific Coast division, had also been general factories manager for the company's Oakland and Los Angeles plants. He first joined Owens-Corning in 1946 as project engineer in charge of designing, constructing and organizing a new plant in Santa Clara.

Carl L. Meng (M. '44; F. '59), age 65, at different stages in his career was employed by the Southern Pacific Railroad, the city engineer of Phoenix, Ariz., and the Glen Acres Water Company which he served as manager. Later, as a consulting engineer he maintained offices in Phoenix. At the time of the Normandy Invasion he was serving in France as chief of Construction Section Headquarters of the First U.S. Army.

Harold William Morgan (A.M. '41; M. '59), age 59, who first joined the American Bridge Division of the U.S. Steel Corporation in 1923, at the time of his death was manager of the firm's Birmingham plant. Mr. Morgan had held this position since 1946.

Philip F. Morgan (M. '52; F. '59), age 49, mayor of Iowa City in 1959, professor of sanitary engineering at the State University of Iowa since 1948 and a nationally recognized authority on sanitary engineering, died recently. A 1956 winner of the ASCE Research Prize, his laboratory at the Iowa City sewage treatment plant, was one of the leading centers of research for the disposal of sewage wastes in the country. Earlier, he had served as president of the Iowa Section.

W. Sherman Smith (A.M. '33; M. '59), age 68, since 1915 a faculty member of Ohio State University, at the time of death was assistant dean of the College of Engineering there. Before his promotion, Professor Smith specialized in traffic engineering.

Richard W. Tull (A.M. '05; M. '59), age 82, retired since 1939, was for many years vice president of the Mitchell Tappen Company. For another 15 years he was engineer and contracting manager for the Eastern Steel Company and for three years was sales agent for the Grating Hendrick Manufacturing Company.

Joseph A. Wahler (M. '37; F. '59), age 66, for the past three years had served as construction engineer with the Corps of Engineers at the Edward Missile Test Station in Baron, Calif. In preceding years as a consulting engineer, he specialized in thin shell concrete construction using the Airform-Gunite Method, which he had helped to develop earlier as chief engineer of the Airform International Construction Company, of New York City.

W. Earl Weller (M. '20; F. '59), age 77, was a former director of the Rochester Bureau of Municipal Research. His contributions to the City of Rochester (N.Y.) were made in the fields of finance, capital improvements, water supply, public works, fire and police protection, consolidation of government functions, schools, welfare, and the Civic Center. He served as director of the Research Bureau from 1928 until his retirement in 1956.

William Robertson Welty (A.M. '47; M. '59), age 48, designing engineer of the Traffic Engineering Section of the Texas Highway Department, was instrumental in developing the accident record and coding system that is currently used by the department. Mr. Welty, who joined the Highway Department in 1941, spent 1945 at Yale University on an Automotive Safety Foundation Fellowship.

Chester C. Woodburn (M. '43; F. '59), age 66, from 1923 until 1954 was a partner in the Des Moines (Iowa) firm of Douglas, Rich and Woodburn. Since the latter year he had been a partner in another Des Moines firm, Woodburn and O'Neil.

Frederick H. Zurmuhlen (M. '41; F. '59), age 63, as commissioner of public works of New York City for the last 13 years directed the greatest building program in New York's history. Mr. Zurmuhlen served in that post under three mayors—longer than any of his predecessors. Chief among the projects he supervised were the $150-million hospital expansion program and the $300-million pollution control program. Previously, he had maintained a consulting practice and was in charge of construction of the U.S. Army base at Trinidad in the British West Indies.

Hardly! You see, Transite®, the *white sewer pipe*, is made of ageless minerals—asbestos and cement. The asbestos fibers, each with the tensile strength of piano wire, reinforce the cement to form a stone-like pipe that is rugged, tough and durable. Transite is also steam-cured under high pressure, adding further to its strength, durability and chemical stability. And, being non-metallic, there's no chance of oxidation weakening its structure. What's more, Transite's high crushing strength can withstand the heavy overburden, ground movement and earth shocks that continually challenge the ability of sewer pipe. When you add to this Transite's long lengths, tight joints and naturally smooth interior, it becomes obvious that this white sewer pipe was designed to offer greater total life expectancy.

For all the facts, write for special data file. Please indicate if you are a city official, engineer or contractor. Address: Johns-Manville, Special Sewer Data, Box 14, CE-4, New York 16, N. Y. In Canada: Port Credit, Ont. Cable address: Johnmanvil.

The Transite Pipe shown in this 23-year-old photo is still providing trouble-free service.

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New in education

Programs in sanitary engineering . . .

A research program to develop a more economical and effective means for treatment of wastes, will be continued at the *Case Institute of Technology* as a result of two continuation grants—with a combined total of more than $67,000—from the U.S. Public Health Service. Under the direction of Dr. Leon Weinberger, M. ASCE, associate professor of civil and sanitary engineering, the program is part of an increasingly important step toward strengthening graduate work in sanitary engineering. Currently under construction and soon to be available are expanded sanitary engineering facilities in the new Metallurgy Building.

The *California Institute of Technology* is now functioning under a greatly amplified graduate program of engineering in environmental health. The program, largely for candidates for the Ph.D. degree—most of whom will spend three years or longer at the Institute—has as its aim to explore new engineering principles in various phases of environmental health. To this end, three of the five floors in the new W. M. Keck Engineering Laboratory will be utilized for sanitary engineering, hydraulics, and water resources. Forms should be addressed to the Dean of Graduate Studies, California Institute of Technology, Pasadena, Calif.

Engineers interested in radiological waste disposal and radiological protection will find *Washington State University's* expanded graduate program in environmental health of significant value. For, in addition to a program emphasizing water supply and waste water disposal, a strong option in radiological health has been included, as well as new required courses in sanitary chemistry and microbiology. The expansion, however, is not limited to curriculum, but involves new laboratory facilities and additions to both the instructional and research staff. For more detailed information, such as research assistantships and other types of financial support, write to G. H. Dunstan, Professor of Sanitary Engineering, Washington State University, Pullman, Wash.

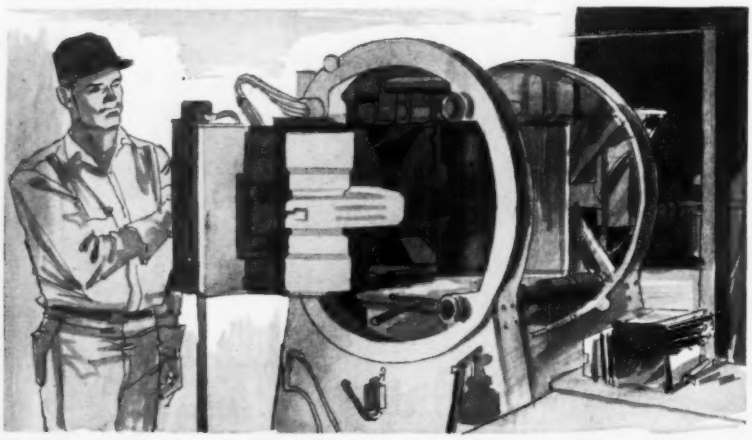
Three major grants totaling $310,000 have been made to the environmental engineering program at *Northwestern University*. The grants, all from the U.S. Public Health Service, will be awarded over a five-year period. They provide for graduate fellowships, additional courses and new research facilities in air pollution, urban planning aspects of environmental engineering, and sanitary chemistry. For details on the grants write to the Office of Information Services, Northwestern University, Evanston, Ill.

PCA summer fellowships at Purdue . . .

The Portland Cement Association has made 20 fellowships to the Graduate School of *Purdue University* available for the summer session starting June 19 and ending August 11. The free-grant awards will benefit qualified instructors and members of civil engineering departments with special interest in highway planning, design and portland cement concrete technology. In addition to payment of tuition, fees and transportation, fellowships also include a cash stipend of $700. Application forms from Professor K. B. Woods, School of Engineering, Purdue University, Lafayette, Ind.

Latest in surveying . . . . . .

San Diego State College is using a unique electronic unit in its engineering-surveying curriculum this year. The Electrotape, the latest development in the art of surveying, will be used in all undergraduate engineering courses and, in addition, will be made available to senior engineering and graduate students for independent experiments. Almost as simple to operate as a portable radio, the Electrotape gives instantaneous distance information over spans from 250 ft to 100 miles.



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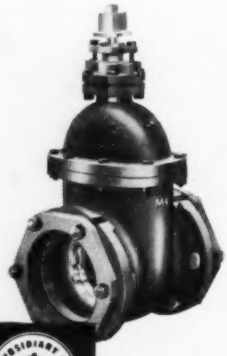

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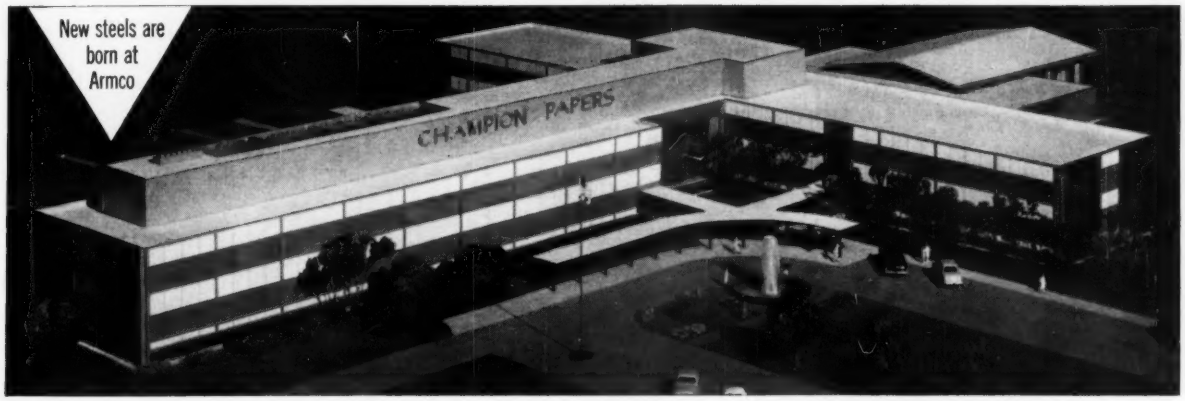
Photo of model of new office building of The Champion Paper and Fibre Company. Structure is nearing completion.



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Architects: Harry Hake & Harry Hake, Jr., Cincinnati; Winkler, Ranck and Beeghly, Hamilton, Ohio

At Hamilton, Ohio, The Champion Paper and Fibre Company is completing a new General Office building. Armco Pipe Piles provide a foundation for this contemporary structure.

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Inspector, with mirror in bright sun, checks interior of Armco Piles for alignment.

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Sewage Regulator

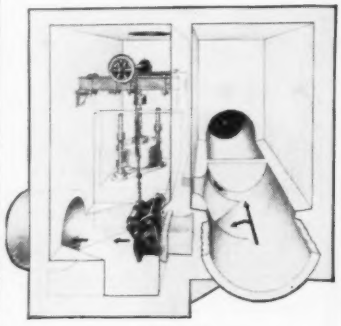

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

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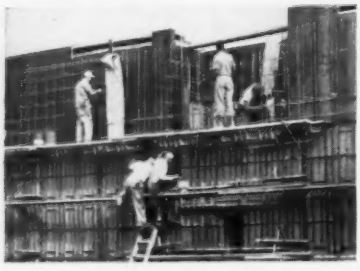

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Applications for Admission to ASCE, Dec. 24, 1960-Jan. 28, 1961

Applying for Member

RUPCHAND MANSINGH ADVANI, Jodhpur (Rajasthan) India
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LEWIS LOWENSTEIN ZICKEL, Atlanta, Ga.

[*Applications for the grade of Associate Membership from ASCE Student Chapter Members are not listed.*]

Non-ASCE Meetings

American Institute of Architects. Annual convention in Philadelphia, April 24-28.

American Power Conference. Twenty-third annual meeting at the Sherman Hotel, Chicago, Ill., March 21-23.

American Society of Photogrammetry and the American Congress on Surveying and Mapping. Meeting at the Shoreham Hotel, Washington, D.C., March 19-25.

American Welding Society. Forty-second annual convention and welding exposition at the Commodore Hotel and the Coliseum, New York, N.Y., April 17-21.

Earthmoving Industry Conference. Twelfth annual conference at the Pere Marquete Hotel and Madison Theatre, Peoria, Ill., April 4 and 5.

National Association of Soil Conservation Districts and the National Reclamation Association. National Water Research Symposium, Sheraton-Park Hotel, Washington, D.C., March 28-30.

National Watershed Congress. Eighth National Watershed Congress at Ramada Inn, Tucson, Ariz., April 17-19.

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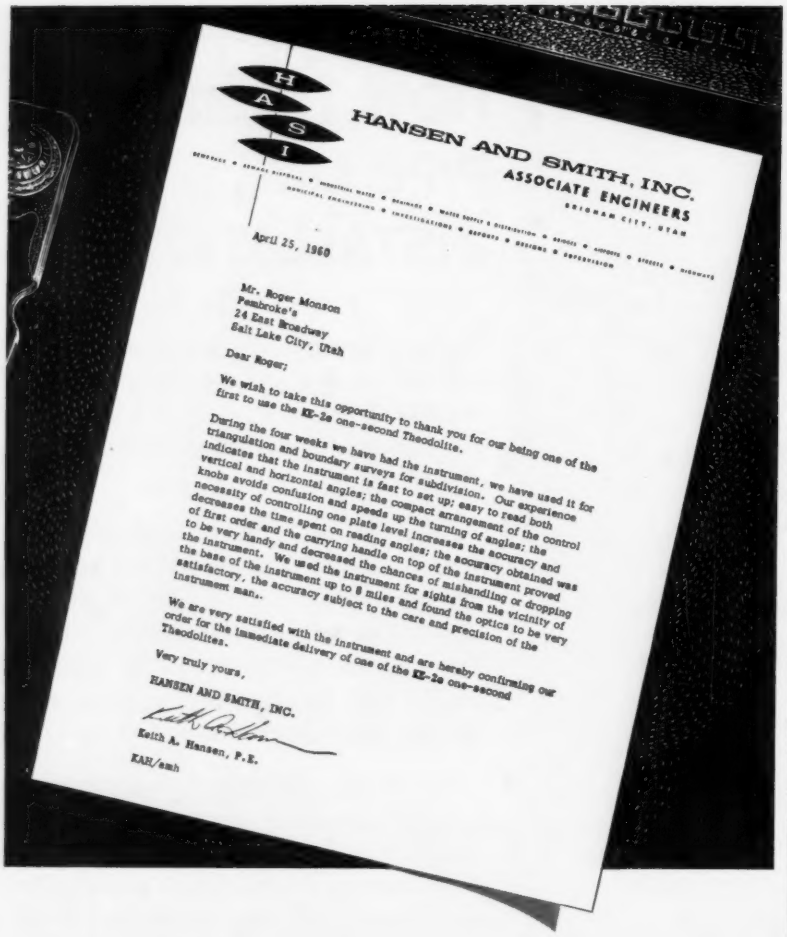
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New Publications

Soils . . . . The Bureau of Reclamation has published a new edition of its "Earth Manual," a successor to the 1951 edition that has been sold out. Although intended primarily for Bureau of Reclamation personnel, the Manual will also be of interest and benefit to others engaged in earth construction work. Copies, priced at $3.75, may be obtained from the U.S. Government Printing Office, Washington 25, D.C., or the Bureau of Reclamation, Denver, Colo.

Graduate School . . . . The student's view of how to get into—and through—graduate school has been released by the American Society for Engineering Education. The new publication, entitled "The Road to Graduate Study," was prepared by students in the University of Illinois chapter of Tau Beta Pi, and features the student approach to a variety of practical problems. It was published by ASEE's Committee on the Development of Engineering Faculties, with Ford Foundation support. Free copies from the ASEE, University of Illinois, Urbana, Ill.

Consulting engineers . . . . A blueprint to follow in preparing consulting firm brochures has been published by the Consulting Engineers Council in the form of a 24-page booklet, entitled "Preparation of a Consulting Engineer's Firm Brochure." The publication, said to be the first of its type, is aimed at acquainting consulting engineers with the possibilities of this facet of public relations. Inquiries should be addressed to the Consulting Engineers Council, Springfield, Ill.

Concrete . . . . More than half a century of important writing in the field of concrete technology is recorded in the "ACI 55-year Index, 1905-1960," just published by the American Concrete Institute. The Index is a comprehensive guide to some 18,000 technical papers which appeared in the ACI Proceedings from 1905 to 1929 and in the monthly ACI Journal (that succeeded the Proceedings) from 1929 to 1959. Entries are indexed by title, author, and major subject classification. The Index, priced at $9.00, may be ordered from the American Concrete Institute, P.O. Box 4754, Redford Station, Detroit 19, Mich.

Water resources . . . . Growth in population and industry will force northwestern Ohio cities and towns to turn to Lake Erie for their water supply. This forecast is made in an inventory of water resources in the Maumee River Basin, just released in book form by the Ohio Division of Water. The report covers the 4,856-sq mile Ohio portion of the Maumee River basin and deals with 17 counties and 62 municipalities that have public water systems. Copies are available from the Ohio Division of Water, 1562 West First Avenue, Columbus 12, Ohio, at the printing cost of $3.85.

Transportation research . . . . Results of a study conference, held in August 1960 under the auspices of the National Academy of Sciences to review transportation activities in the United States, and to prepare suggestions for improving the national situation, are reported in Publication 840 of the National Academy of Sciences—National Research Council. The report sells for $1.00, and is available from the Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, Washington 25, D.C.

Masonry standards . . . . "Building Code Requirements for Reinforced Masonry," by American Standards Committee A41, has been issued as National Bureau of Standards Handbook 74 and may be ordered from the U.S. Government Printing Office, Washington 25, D.C. It is 15 cents. The reference is one of a series of related standards being developed by various committees under the Construction Standards Board of the American Standards Association.

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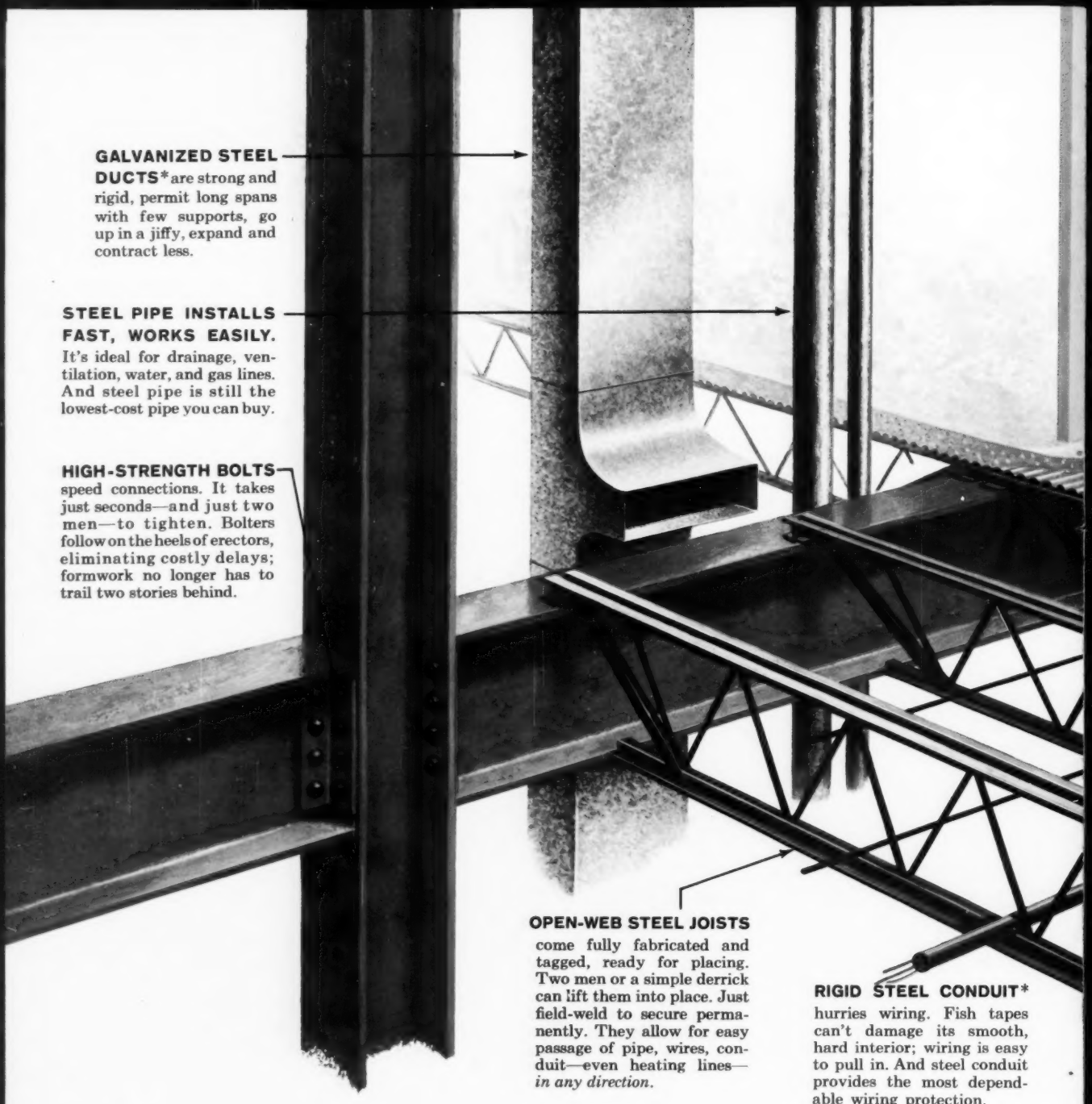

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STEEL PIPE INSTALLS FAST, WORKS EASILY. It's ideal for drainage, ventilation, water, and gas lines. And steel pipe is still the lowest-cost pipe you can buy.

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SHOP-FABRICATED STRUCTURAL STEEL arrives at the site ready to go into place. No expensive, time-wasting operations. A steel framework goes up fast—two stories or twenty-two stories. Long before the frame is completed, other trades get started. Floors, curtain walls, electric wiring, air-conditioning, and plumbing can be installed more quickly.

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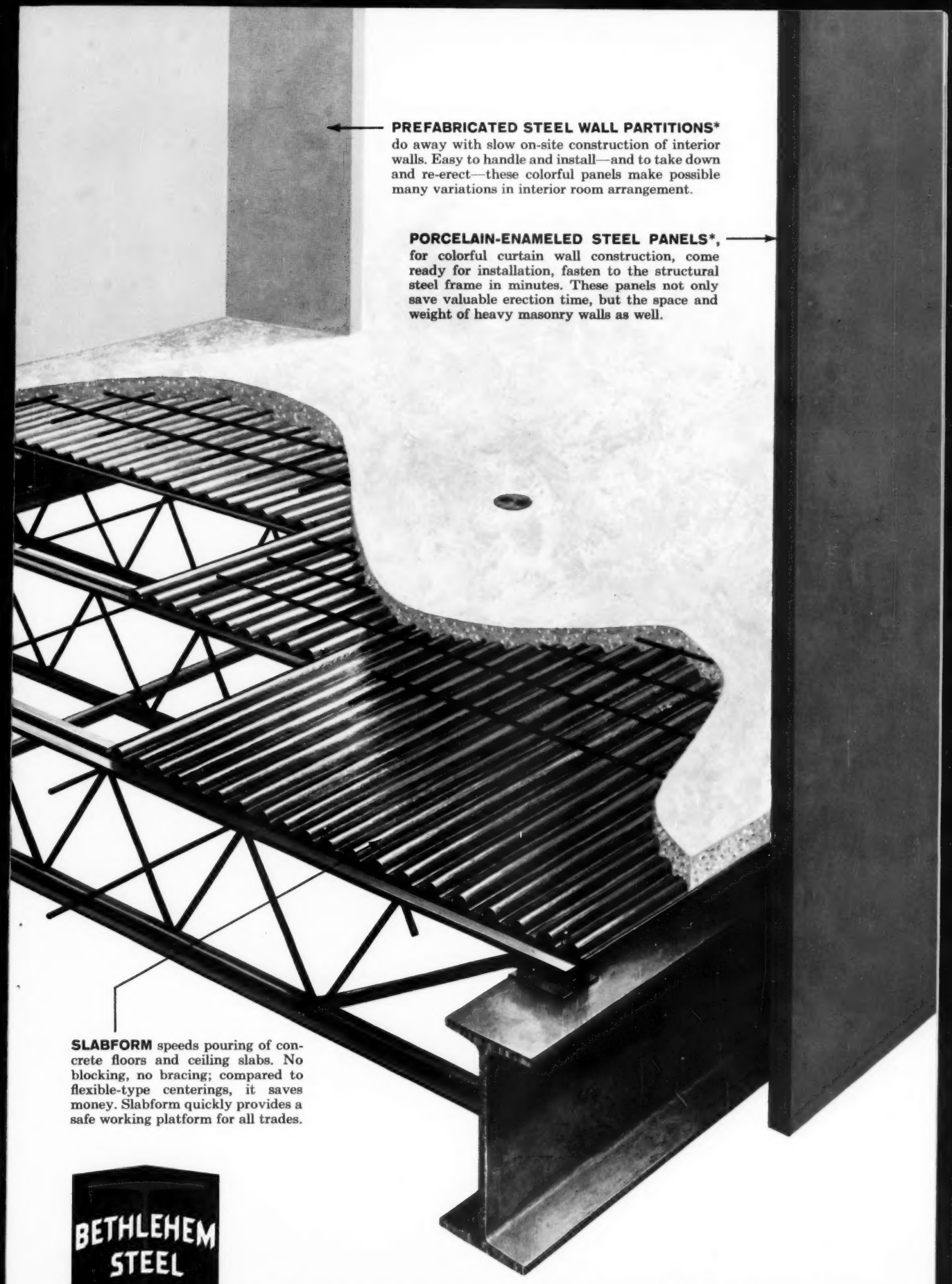

PREFABRICATED STEEL WALL PARTITIONS* do away with slow on-site construction of interior walls. Easy to handle and install—and to take down and re-erect—these colorful panels make possible many variations in interior room arrangement.

PORCELAIN-ENAMELED STEEL PANELS*, for colorful curtain wall construction, come ready for installation, fasten to the structural steel frame in minutes. These panels not only save valuable erection time, but the space and weight of heavy masonry walls as well.

SLABFORM speeds pouring of concrete floors and ceiling slabs. No blocking, no bracing; compared to flexible-type centerings, it saves money. Slabform quickly provides a safe working platform for all trades.

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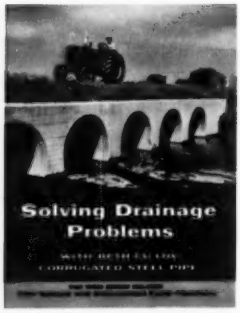
**Bethlehem does not make these finished products, but does supply new Bethnamel sheets for porcelain-enameled curtain walls; cold-rolled steel sheets for wall partitions; Bethcon galvanized steel sheets for ductwork; and steel pipe for rigid steel conduit.*

Do you have these booklets ?

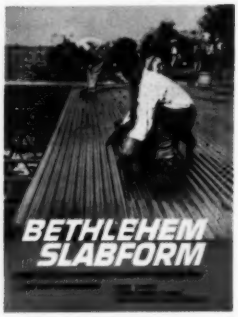
No. 549 Describes Bethlehem's role in fabricating and erecting 53,000 tons of steelwork for the Chase Manhattan Bank Building in New York.



No. 425A This informative manual on corrugated sheet steel pipe includes tables for evaluating flow friction and other practical data.

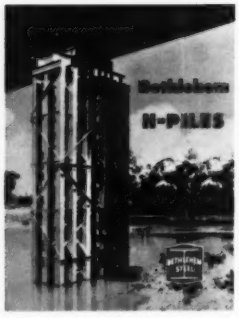
No. 553 Describes details of both "S" series and "L" series joists. Includes standard loading tables, accessories, specifications.

No. 582 Complete information on Bethlehem's 11 new lightweight wide-flange structural beams.



No. 683 Advantages and placing directions for Slabform, a solid centering for steel-joist and poured-slab construction.

No. 563 Guide for high-strength bolting. Also available: literature describing standard and special fastener products.

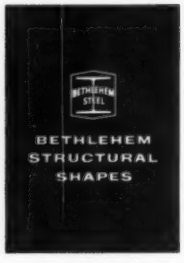


No. 223 Describes a wide variety of installations. Also available: No. 433, Steel Sheet Piling.

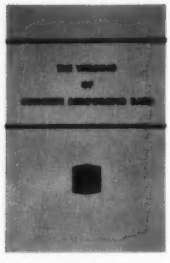
No. 569 Reprints ASTM Specifications on 6 grades of structural steel which meet 98 per cent of all usual requirements.

No. 493 Recommendations for construction applications. One of many publications for users of wire rope, strand, and fittings.

No. 393B Complete information on continuous butt-weld and electric resistance-weld steel pipe.



No. S-58 Describes standard beams and columns, with information and tables helpful to designers.



No. 527A Describes joint details and recommended procedures for welding reinforcing bars.

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News of Members

(Continued from page 28)

B. H. Hoffmaster recently assumed new duties as flood control engineer in the San Diego Department of Public Works. Earlier he was employed as senior hydraulic engineer in the planning section of the California Department of Water Resources in Sacramento.

J. Robert Moore, associate partner and Memphis office manager of Harland Bartholomew and Associates, is currently in Agadir, Morocco, detailing a broad-scale master plan—recently completed by the firm—for the city devastated by earthquake on February 29, 1960. The project is being carried out in conjunction with the Moroccan Ministry of Public Works, under the sponsorship of the International Cooperation Administration. Mr. Moore is a director of the Mid-South Section.

L. S. Morgan has terminated his employment with the Pennsylvania Department of Health as chief of the Mine Drainage Section, Greensburg, after more than 36 years in the Department. As the new director of environmental health of the Bucks County (Pa.) Department of Health, he will maintain an office in Doylestown.

Robert J. Jackson, Jr., Lieutenant Colonel, Army Corps of Engineers, has a new assignment as chief of the facilities branch, Comptroller Division in the Office of the Chief Signal Officer. In recent years he has been post area command engineer for the Signal Corps in the La-Rochelle area of France.

William Robert Scherwat has resigned as field engineer with the Portland Cement Association to accept a position with Engineering Service Corporation, architects and engineers of Decatur, Ill.

Robert B. Hickok, recently resumed work in soil and water conservation research with the Watershed Technology Research Branch of the U.S. Department of Agriculture's Soil and Water Conservation Research Service at Beltsville, Md., after four and a half years with the Air Research and Development Command of the Air Force Ballistic Missiles Division in Los Angeles.

James H. Holcombe, Lieutenant Colonel, Corps of Engineers, has taken up new duties as assistant engineer at McConnell Air Force Base in Kansas. Recently he has been chief of the construction and real estate branch of J-4 Section in Alaska, and commanding officer of the Second Engineer Battalion at Fort Leavenworth, Kans.

Phil M. Ferguson, professor of civil engineering at the University of Texas, was installed as president of the Texas Society of Professional Engineers at its annual meeting, held on January 21. At the present time Professor Ferguson is president of the American Concrete Institute and chairman of the ASCE Committee on Masonry and Reinforced Concrete.

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ASTM Specifications for Steel Piping Materials

Seventh Edition

Includes more than 90 specifications, over half of them revised since the 1959 edition. They cover pipe used to convey liquids, vapors and gases at normal and elevated temperatures, still pipes for refinery service, heat exchanger and condenser tubes, boiler, superheater and economizer tubes, and the castings, forgings, bolting and welding fittings used in such installations. (Published by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1960. 523 pp., bound. $7.00.)

ASTM Standards on Bituminous Materials for Highway Construction, Waterproofing, and Roofing

Eighth Edition

Containing over 100 specifications, methods of test, and definitions, this 1960 compilation serves as a guide for the production of bituminous materials, and their use in highway and building construction. Over 40 standards are new, revised, or have had their status changed since the 1958 compilation. New material includes items dealing with hot-mixed, hot-laid asphalt paving mixtures, woven glass fabrics saturated with bituminous substances for waterproofing use, coating and stripping bitumen-aggregate mixtures, and outdoor weathering of bituminous materials. (Published by the American Society of Testing Materials, 1916 Race Street, Philadelphia 3 Pa., 1960. 475 pp., bound. $5.50.)

ASTM Standards on Mineral Aggregates and Concrete

Ninth Edition

A compilation of approximately 134 standard specifications, methods of test, recommended practices and definitions of terms, for mineral aggregates, concrete, concrete curing materials, expansion joint fillers, reinforcing steel, paving block and brick, and bituminous and non-bituminous road material. Of this number, 50 are new, revised, or have had their status changed since the 1958 compilation. Selected items deal with bituminous road materials. A companion volume affords complete coverage in this field: "ASTM Standards on bituminous materials for highway construction . . . ," 1960. (Published by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1960. 396 pp., bound. $5.75.)

Bestimmungen des Deutschen Ausschusses Fur Stahlbeton

Seventh Edition

A compilation of German specifications and standards in the field of reinforced concrete covering materials, test methods, structural elements, and construction details. There is an extensive subject index. (Published by Verlag von Wilhelm Ernst & Sohn, Berlin, Germany, 1960. 543 pp., bound. DM 19.80)

Design of Prestressed Concrete Beams

Presents tables and design methods intended to reduce the amount of trial and error usually encountered in determining the cross-section of simply supported prestressed concrete beams. The tables are not limited to members of any particular proportions or dimensions, and are applicable to I-beams, T-beams, long-span members, and composite sections. The major emphasis in the methods presented is on the elastic design for bending, but attention is also given to prestress losses, shear, and ultimate flexural strength. (By William H. Connolly. F. W. Dodge Corporation, 119 West Fortieth Street, New York 18, N. Y., 1960. 252 pp., bound. $11.50.)

Deutscher Ausschuss Fur Stahlbeton

This publication includes three papers: investigation of the pressure exerted on forms during the pouring of concrete; compressive strength of concrete in the upper zone after compaction by internal vibration; tests on the compaction of concrete in forms both unattached and attached to the vibrating table. (Published and distributed by Verlag von Wilhelm Ernst & Sohn, Berlin, Germany, 1960. 46 pp., paper. DM 13.00.)

Energy in the American Economy, 1850-1975

A survey publication of Resources for the Future, Inc., which examines the sources, supply, and use of energy in the U.S. during the years 1850-1975, their place in the economic development of the country, and the future energy picture. Projections of the future are considered in the introductory section, which summarizes and evaluates the findings and conclusions of the other sections and, on this basis, discusses the future. Part I presents a historical analysis of the statistical record of energy supply and demand in the U.S. over the past 100 years, and Parts 2 and 3 evaluate the future energy position of the U.S., both in terms of its growing needs, and of its ability to satisfy them from domestic resources. (By Sam H. Schurr and Bruce C. Netschert. The Johns Hopkins Press, Baltimore 18, Md., 1960. 774 pp., bound. $12.50.)

Highway Research Board Proceedings

The Proceedings of the 39th annual meeting, held in Washington, January 11-15, 1960. Forty-one papers discuss land locomotion by highway from the standpoints of economics, finance and administration, design, materials and construction, maintenance, traffic and operations, and soils. Also contained in this volume are lists of HRB officers, personnel, member organizations, departments and committees, an index of papers and reports appearing in other HRB publications, notes on awards conferred, and minutes of the 1959 business meeting. (Published as Publication No. 773 by the National Academy of Sciences-National Research Council, Washington 25, D.C., 1960. 728 pp., bound. No price given.)

International Association for Bridge and Structural Engineering—Sixth Congress, 1960

This volume includes over 50 selected papers by authors from the U.S.A., Europe, and the USSR. The five themes covered, each introduced by a general report, are: (1) the basis of structural design, (2) metal structures, (3) steel skeletons, (4) bridge building, and (5) prefabricated structures. A sixth section presents new developments in bridge and constructional engineering and includes a paper on nuclear power stations and one on nuclear reactor structures. Papers are in English, French, or German, with the general reports and summaries of the papers in all three languages. (Verlag Leemann, Zurich, Switzerland, 1960. 928 pp., bound. SF 70.)

Prestressed Concrete—2 Volumes

Fourth Edition

A free translation of M. Guyon's "Béton Précontraint" appeared in 1953. This present two-volume set, the work of the 1953 editor, translators, and publishers, consists of the first volume of the 1953 English edition with a 15-page supplement of revisions, and the first English version of the second volume. Worked examples and test results have been recast using British dimensions. Volume I is concerned only with statically determinate straight beams, dealing (in Part 1) with such general considerations as prestressing methods and materials, friction between cable and duct, fire resistance, bond phenomena, and anchorage stresses, and (in Part 2) with elastic design of simply supported beams. Volume II deals with elastic analysis and testing of statically indeterminate structural systems such as beams and assemblies of beams —arches, portal frames and multi-storied framed structures—and certain types of slabs. (By Y. Guyon. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1960, bound. $33.00.)

Symposium on Road and Paving Materials—1959

The first section of this book contains a comprehensive progress report, and two papers dis-

(Continued on page 104)

101 Buildings Studied

Hope-Witheron Building, San Diego
Towne House, Harrisburg, Pa.
Thomas Jefferson Bldg., St. Louis
Plaza Apartment Bldg. No. 10, St. Louis
Plaza Apartment Bldg. No. 20, St. Louis
Plaza Apartment Bldg. No. 30, St. Louis
Plaza Apartment Bldg. No. 40, St. Louis
Plaza Apartment Bldg. No. 50, St. Louis
Plaza Apartment Bldg. No. 60, St. Louis
1221 Minor Building, Seattle
Manhattan Bldg., Seattle
Logan Bldg., Seattle
Mark 51 Bldg., Seattle
Carlton House, Shaker Heights, Ohio
Broadway & Austin Bldg., San Antonio
215 N. Flores Bldg., San Antonio
Bayview Office Bldg. Addn., Ft. Lauderdale
Versailles Apartments, Ft. Lauderdale, Fla.
Birch Towers, Ft. Lauderdale
Breakwater Towers, Ft. Lauderdale
Massachusetts Blue Cross, Boston
Crimson Associates Bldg., Cambridge, Mass.
Babson Bldg., Boston
University Towers, New Haven
Woodland Medical Center, Hartford, Conn.
Strawberry Hill Terrace, Stamford, Conn.
1720 West End Bldg., Nashville
Park Towers, Baltimore
Hood-Hall Bldg., Dallas
Continental Apartments, Dallas
Empire Bldg., Salt Lake City
Dunleith Manor, Kansas City, Mo.
Quality Hill Towers Bldg., 910 Kansas City, Mo.
Old Security Life Ins. Bldg., Kansas City, Mo.
Fidelity Bldg., Indianapolis
Grain Dealers Mutual Ins. Co., Indianapolis
St. Paul Fire & Marine Insurance Co., St. Paul
Cheeseman Towers Apartments, Denver
777 Grant Bldg., Denver
Bankers Union Life Bldg., Denver
1710 "H" Street, Washington
1901 Pennsylvania Ave., Washington
Mercury Bldg., Washington
Premier Bldg., Washington
R. C. A. Bldg., Washington
Bender Bldg., Washington
Potomac Towers, Arlington, Va.
3900 Watson Place, Bldg. A., Washington
3900 Watson Place, Bldg. B., Washington
Railway Labor Building, Washington
City Bldg., Washington
Whispering Waters, St. Petersburg, Fla.
Union Bank Bldg., Beverly Hills, Calif.
Independence Life Insurance Bldg., Pasadena
Cornelius Plaza, Portland, Ore.
Park Vista, Portland, Ore.
Bernard Horn Bldg., Cincinnati
2300 Luray Bldg., Cincinnati
Liberty Mutual Ins. Bldg., Boston
Cornet Bldg., Clayton, Mo.
Maylee Bldg., Cleveland Heights
National Cash Register Bldg., Cleveland
The Diplomat, Shaker Heights, Ohio
1674 Meridian Bldg., Miami Beach
1919 Bay Drive Bldg., Miami Beach
Southgate Towers, Miami Beach
Hartford Federal Savings & Loan, Hartford, Conn.
Gateway Center No. 4, Pittsburgh
Medical Center Office Bldg., Pittsburgh
Blue Cross Bldg., Dallas
Vaughn Bldg., Dallas
Presidential Apartments, Chicago
Calhoun Terrace Apartments, Minneapolis
Imperial Apartment Hotel, Denver
Park Adams, North Arlington, Va.
First Federal Savings & Loan, St. Petersburg
Western Geophysical Bldg., Los Angeles
Signal Oil Bldg., Los Angeles
California Bank Bldg., Los Angeles
Pacific Fidelity Life Insurance, Los Angeles
Ohio River Vista Apartments, Cincinnati
411 Oak Bldg., Cincinnati
Winebrenner Haven, Findlay, Ohio
College Terrace, Brooklyn
45 E. 72nd St., New York
Bankers Trust Bldg., New York City
201 E. 15th St., New York City
The Park East, New York City
IBM Bldg., Detroit
1st Ave. & 56th St., New York City
1733-49 E. 12th St., Brooklyn
Ocean Towers, Brooklyn
Ocean Terrace, Brooklyn
345 Webster Ave., Brooklyn
American Field Service Bldg., New York City
140 E. 44th St., New York City
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Bolton Manor, New York City
300 E. 51st St., New York City
30 West Broadway, New York City

National Study of 101 new Buildings reveals definite superiority of Structural Steel

Impartially selected, 43 of the studied buildings are framed in structural steel, 58 are reinforced with steel

Here are the results . . .

Speed— Buildings framed in structural steel went up 45% faster. From ground breaking to occupancy, buildings framed in structural steel progressed at the rate of 123,241* cu. ft. per month, compared with 85,240* cu. ft. per month for structures reinforced with steel. (Structural steel's greater speed was substantial regardless of project size.)

Cost— Almost identical, regardless of framing material. Buildings framed in structural steel averaged $1.54 per cu. ft., compared with $1.48 per cu. ft. for buildings reinforced with steel, an apparent 4% premium for structural steel. However, steel-framed buildings were 95.6% air-conditioned, as against 78.1% for steel-reinforced buildings. With air conditioning amounting to an average of 6% of total building cost today, simple calculation reduces the differential to 2.9%, which is offset by the revenue produced by earlier occupancy of steel-framed structures. (Average annual rental rate for these buildings was $3.88 per sq. ft.)

Conclusions? Draw your own.

Study Specifications:

All building foundations were begun after Jan. 1, 1958. All buildings were occupied before Nov. 30, 1960. Buildings ranged in height from 4 to 21 stories. (59 from 4 to 9 stories, 29 from 10 to 15 stories and 13 from 16 to 21 stories.) Office and apartment buildings, selected at random and located in all parts of the country, were studied by impartial construction survey specialists. None of the projects involved abnormal delays beyond the control of the contractor.

For more details on this study, write to American Bridge Division, U. S. Steel, Room 1801L, 525 William Penn Place, Pittsburgh 30, Pa.

*Applies to total construction time, not simply frame.

American Bridge Division of United States Steel

A Guide to OP and VP

Gurley Optical Plummet

The Optical Plummet Transit opens new avenues in accuracy, speed and convenience...eliminates inconvenience and lost time involved in centering a plummet over a point.

The Optical Plummet is a telescope through the vertical center (spindle) of a transit. It will point vertically when the transit plate is level. The telescope is turned at right angles by a prism, so that vision is actually horizontal. Setting and adjustment may be checked very simply and precisely by rotating the instrument 180 degrees.

The Gurley Shifting Head Tripod permits 1¾" movement of the transit in two directions 90° separated, without material disturbance to the level of the plate (the Optical Plummet thus remains operative through the entire centering procedure).

Advantages of the Gurley Optical Plummet Transit

- Saving in set-up time, as much as 33%—a factor when a crew is waiting.
- Eliminates swaying plumb bob.
- More accurate centering over point.
- On construction work—sights on points some distance below, such as encountered in bridge work and building construction.
- Made in U.S.A.—Little servicing, but easily repaired when necessary.

Gurley Optical Plummet Transits Available in 21 Combinations

With Circular Compass	With Trough Compass	Without Compass
OP-52	—	OP-57
OP-62	—	OP-67
OP-132	OP TC 137	OP-137

And with limb reading to 1 min.; or 30 sec., or 20 sec....Stiff-leg or Extension-leg Tripods with Constant-Level Shifting Head and wide-frame European-type construction.

Variable Power is standard on Gurley Transits and Levels:

- Wide range of magnification with **one** eyepiece—zooms for near or distant objects
- Easily adjusts to suit weather and light conditions
- Built-in haze filter

At high power:
- longer shots
- less glare in bright sunlight
- increase in readability
- no glare...high contrast
- blacks and whites stand out

At low power:
- greater field
- brighter field
- decrease of heat waves

We will be pleased to send you further information about both Gurley Optical Plummet Transits and Gurley Variable Power Eyepiece.

Both Optical Plummet and Variable Power are patented.

W. & L. E. Gurley · 518 Fulton St., Troy, N.Y.

cussing results of extensive tests on asphalt, including the microfilm durability test, all relating to research work carried out on the Zaca-Wigmore Experimental Test Road, a project of the California Division of Highways and Pacific Coast asphalt producers, begun in 1954. The second section contains four papers which discuss the prediction of performance of asphalt in terms of chemical composition, the flexibility characteristics of asphaltic paving mixtures as influenced by temperature, and degradation of aggregates employed in asphalt pavement structures. (Published as ASTM Special Technical Publication No. 277 by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., 1960. 126 pp., bound. $3.50.)

Technology Engineering and Safety
Volume Two

Selected papers from the Second International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958. These are mainly review papers, rather than reports of original work. They have been coordinated and edited to illuminate the unified theme of "reactor technology" irrespective of the geographical location of the authors. The papers are arranged in groups dealing with reactor chemistry, reactor materials, engineering experience and practice, engineering studies, and engineering aspects of reactor safety. (Edited by R. Hurst, R. N. Lyon and C. M. Nichols. Pergamon Press, 122 East 55th Street, New York 22, N. Y., 1960. 799 pp., bound. $15.00.)

Library Services

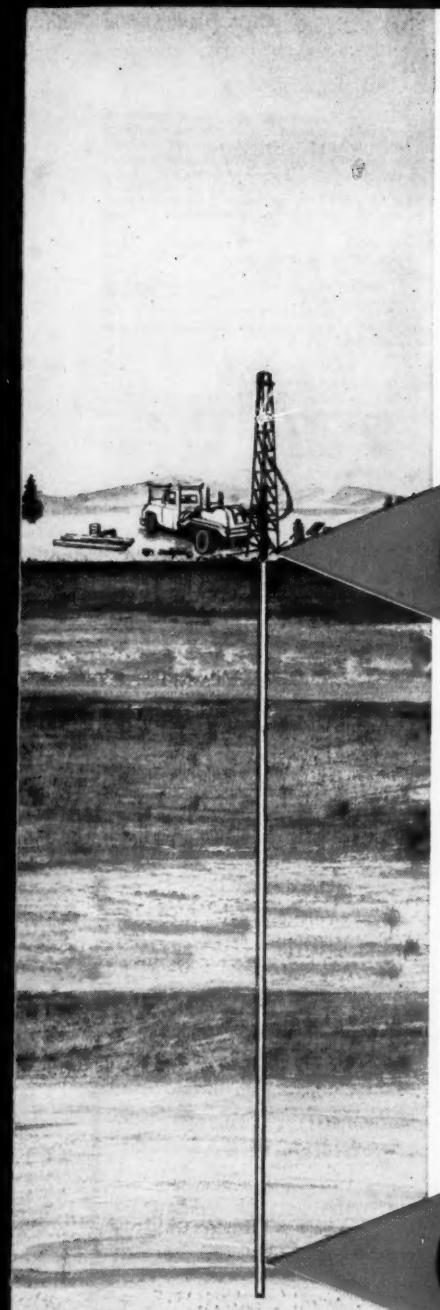
Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by ASCE members for a small handling charge. The library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies library. 29 West 39th Street, New York 18, N. Y.

1301 Review Problems

The purpose of this book is to provide an intensive practical review for persons planning to take the PE registration examination and the prerequisite EIT (Engineer-in-Training) exam. Individual problems selected from actual state registration exams form the basis of the review. The problems are arranged in two sections, corresponding to the two parts of the EIT exams. The "General" section (Chapters 1-11) covers such subjects as mathematics, chemistry, statics, thermodynamics, fluid mechanics, electricity, engineering economy, ethics, and contracts. The "Applied Engineering" section (Chapters 12-19) covers aeronautical, chemical, civil, mechanical, electrical, industrial and mining engineering, and surveying. The remainder of the book (Chapter 20), contains nine complete typical state examinations. (By Russell C. Brinker and others. International Textbook Company, Scranton, Pa., 1960. 388 pp., bound. No price given.)

Traveling-Wave Engineering

Dealing with distributed parameter systems where the point-to-point traveling time of a disturbance is significant, this book treats transmission lines in detail, applying methods widely used for transmission lines to such "wave" phenomena as vibrating strings and acoustics, and such "diffusion" phenomena as heat conduction and molecular and charge-carrier diffusion. Plane waves are assumed except in the chapter dealing with spherical waves. Basic wave concepts for the transmission line are developed first, with comparable equations for the other waves derived in the following chapter. Thereafter, new ideas are introduced in terms of transmission lines, and the analogous applications of each effect are immediately given. Linear systems only are discussed, and though the analogies are of general applicability, nonlinear waves will require different methods of analysis. (By Richard K. Moore. McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y., 1960. 360 pp., bound. $11.00.)



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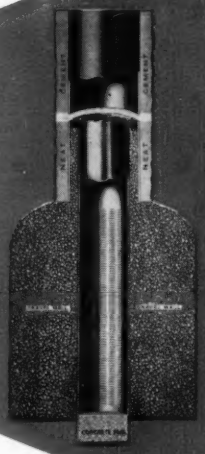

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These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Chemical, Electrical, Mechanical and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular placement fee. Upon receipt of your application a copy of our placement fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application.

Men Available

CIVIL OR STRUCTURAL ENGINEER, design, Student Member ASCE, M.S.E. in civil engineering. Three years as sectional officer in engineering department of the Ahmedabad Municipal Corp., in India; in the design and supervision of constructional plants. Salary, $6,300 a year. Location, U.S. or foreign. C-652.

CHIEF ENGINEER, F. ASCE, M.S.C.E. Structural and mechanical design of industrial structures and machinery in bulk and package handling conveying equipment and earth moving equipment. Supervision of engineering department of medium size. Salary, $12,000-$15,000 a year. Location, Midwest or East. C-653.

CHIEF ENGINEER OR PROJECT MANAGER, F. ASCE, B.S.C.E. Twenty years expereience in the design and construction of airports and express highways, familiar with all new developments in design and in construction materials and techniques. Particularly interested in urban transportation problems. Salary, $12,500 a year. C-654.

PLANT ENGINEER, A.M. ASCE, B.S.C.E. Five years of responsible supervisory experience in plant engineering and construction. Complete charge of maintenance, transportation, and utility shop operations and administration. Managed maintenance control and time standards program. Administered maintenance and construction contracts. Civil Engineer Corps officer. Salary, $7,500 a year. C-655.

ASSISTANT PROFESSOR, A.M. ASCE, B.S.C.E., M.S.C.E., Registered Professional Engineer in Mass. Civil engineer with three years' construction and two years' teaching experience at various locations in the east. Qualified to teach surveying and applied mechanics courses. Salary, $7,000 a year. C-656.

STRUCTURAL ENGINEER, M. ASCE, C.E.-educated in Europe, 33. Ten years' experience in reinforced concrete structures, shell structures and good knowledge in prestressed concrete. Five years' experience in teaching structures and doing research work. Salary, $12,000 a year. Presently in Central America but will relocate. C-657.

PUBLIC WORKS ADMINISTRATOR, F. ASCE, B.S. & M.S. in C.E.; P.E.-Okla., Lt. Col., C.E. U.S. Army. Twenty-seven years' experience in construction and maintenance and operation of facilities, including, control of planning, programing, budgeting, costs, and contracting. Salary, $9,000 a year. Location: U.S. Available in 60 to 90 days. C-658.

ENGINEER, M. ASCE, B.C.E., 36. Eleven years' field and office experience including all phases operations (field installation, estimating, negotiating, contracts, sales) for major foundation contractor. Interested in challenging position with management potential. Will relocate. C-659.

JUNIOR SOILS MECHANICS ENGINEERING, A.M. ASCE, B.S., M.S. Civil Engineering. Experience in soil testing laboratory; shear strength, consolidation, etc. interpretation results. Earth dam design, building foundation design. Trainee in highway construction project. Salary, $5,760 a year. Location, New York City. C-660.

STRUCTURAL ENGINEER, structures and foundations; A.M. ASCE, B.S.C.E., M.S., Reg. P.E., 32. Seven years' of design and design supervision of bridges, buildings and waterfront structures. Field work on airfield construction. Salary, $9,000 a year. Prefer, Northeast. C-661.

CIVIL ENGINEER, ESTIMATOR, A.M. ASCE, M.S., B.S. in C.E., Registered P.E. Resident engineer one and a half years, in structural research for two years. Desire position of increased responsibility. Prefer, Northeast. C-662.

MATERIALS OR CONSTRUCTION ENGINEER, A.M. ASCE, B.C.E. Four years as general superintendent of construction, bridges, chemical plants, and commercial buildings; four years in materials engineering—soils, bituminous and cement concretes; and two years in design of highways, drainage structures and bridges. Salary, $12,000 a year. Prefer, Foreign. C-663.

ENGINEERING EXECUTIVE, F. ASCE, C.E., Registered P.E. in five states. Wide industrial and civil experience; all phases administration and management. Organize and direct large design jobs. Excellent at proposals, reports, contracts, liaison, coordination, trouble shooting. Salary, $16,000 a year. Location, U.S.A. C-664.

CONSTRUCTION ENGINEER, A.M. ASCE, B.S.C.E., P.E., New York. Six years as project engineer on highway and bridge construction; and two years as engineer-estimator on highway and foundation construction. Salary, $9000 a year. Location, New York Metropolitan area. C-665.

TEACHING, F. ASCE, degree C.E., majored in bridge engineering; registered P.E. Civil and Structural. Chief structural engineer, since 1952; head of structural design sections for 16 years; design engineer, eight years. Projects include concrete and steel bridges, power plants, industrial buildings, tall buildings. Continuous work in indeterminate structures. Salary commensurate with position. Location, East. C-666.

PROJECT ENGINEER, STRUCTURAL, A.M. ASCE, B.S. & M.S.C.E., 31. Ten years' experience in-

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SENIOR STRUCTURAL DESIGNER, M. ASCE, M.S.C.E., 40. Thirteen years' experience in desgin of heavy industrial steel and reinforced concrete structures, such as crushing and screening plants, ore treatment plants, movable and stationary stackers, bins and hoppers, rigid frames, long span trusses, etc. Salary, $10,000 a year. Location, Chicago. C-2084-Chicago.

SALES OR LIAISON ENGINEER OR DESIGN, A.M. ASCE, B.S. C.E., 32. Eight years with the transportation company doing sales, estimating, design and liaison in relation to pressure vessels and cone roof and floating roof storage tanks. Salary, $9,000 a year. C-2086-Chicago.

Positions Available

ADMINISTRATIVE ENGINEER, familiar with highway design and materials, to coordinate activities of field engineering staff. Some travel in a five-state area. Midwest. W-33.

CIVIL ENGINEERS for a consulting sanitary engineering office on work involving structural design; hydraulic computation and general layout of plant structures and equipment. Sanitary experience preferred in the following classifications. (*a*) Designers, graduates, with two years' experiance in actual design work. Experience with structures, piping and equipment. Salary, $7,200 a year and up. (*b*) Designers, Juniors, graduate civil, with interest in structures, hydraulics, water supply or sewage treatment for design and drafting duties. Salary, $6,000-$7,200 a year. N.Y.C. W-32.

SALES ENGINEERS, with concrete, concrete mix design, or concrete construction experience, to call on architects, engineers, contractors, etc., to obtain specifications for chemicals used in the construction industry (admixtures, sealants, coatings) and to advise and sell contractors or other users; to service projects. Previous experience as sales or service engineer for a portland cement manufacturing company desirable. Good potential. Some travel. Territories: Virginia; Metropolitan N.Y.; Texas. W-20.

PROFESSORS with at least M.S. degree in civil engineering and teaching experience. (*a*) Fluid mechanics; sanitary engineering; hydraulics. (*b*) Statics and dynamics; structural analysis and design; reinforced concrete. One to two-year contract. Transportation from U.S. Middle East. F-12.

ENGINEERS. (*a*) Assistant to director for public works department, civil graduate, with some experience in municipal and county work, especially highways, roads, sewers, etc. Salary, $6,500-$8,000 a year. (*b*) Assistant director, planning board; high level planning experience for public works, subdivisions, etc. Salary, $10,000 a year. (*c*) Assistant to county engineer. Experience same as (*a*). Salary, $6,500-$8,000 a year. New Jersey. W-3.

CIVIL ENGINEERS. (*a*) Civil engineer, graduate, experienced in design, to take charge of a sanitary engineering design and drafting office of a large consulting organization. Salary open. N.Y.C. (*b*) Senior water supply engineer, for design and construction of municipal plants including treating, pumping and distribution. Salary, $11,000-$14,000 a year, plus extras for foreign. Foreign and Domestic. W-9999.

FIELD INSTRUMENT ENGINEER, with experience in field construction on getting a paper plant in operation insofar as instrumentation is concerned. Temporary, four to seven months. Salary, $12,000 a year, plus. Columbia, S.A. F-9988.

CONSTRUCTION MANAGER, to 45, with good engineering background; experienced in the process petro-chemical construction field (tanks, piping systems, vessels, pumping equipment, etc.) Salary to $25,000 a year (foreign currency); transportation furnished for applicant and family. Arabian Gulf. F-9986.

ENGINEERS. (*a*) Civil engineer, graduate, preferably with water supply experience, for fire protection work with long established organization. Work will entail studies and reports of water supply systems in larger cities. Salary, $6,200-$7,800 a year. (*b*) Structural engineer for fire protection work. Will entail studies and reports of buildings and fire prevention codes and of structural and hazardous conditions in larger cities. Salary, $5,200-$7,800 a year. Travel about 50% on both jobs. Headquarters, N.Y.C. or Chicago. W-9968.

SENIOR EDITOR, younger man, with architectural or civil engineering background for a trade publication. Should have worked for architectural or engineering consulting firm, and with technical or editorial writing experience. Salary, $10,000-$15,000 a year. Company pays placement fee. Northern N.J. W-9963.

ENGINEERS. (*a*) Resident engineer with at least 10 years' highway construction experience. Must be able to speak Spanish. Salary, $12,000 a year (*c*) Senior highway location engineer, with about 15 years' experience. Salary, $14,000 a year. All salaries plus living allowance. Duration three to four years. Peru (12,000-15,000 ft. altitude). F-9958.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

CHIEF ENGINEER, graduate civil, with from ten to 15 years' experience in supervisory highway work. Must have poise and diplomacy and be able to work well with state and federal highway officials. Salary, to $15,000 a year. East. W-9879.

CIVIL ENGINEER, preferably graduate with experience in quality control and concrete technology to assist principal quality control engineer in control of concrete and general quality of pre-cast beams, slabs, etc. for three plants located in Ohio and Michigan. Salary, $7,200-$8,600 a year. C-8474.

ASSISTANT OR ASSOCIATE PROFESSOR, M.S. or Ph.D. To teach undergraduate courses including fluid mechanics and mechanics of materials. Opportunity to participate in newly developed research program or consulting. Small university. Salary open. Indiana. C-8467.

PLANT MAINTENANCE ENGINEER, graduate mechanical, civil or electrical. To inaugurate at office level maintenance program for multi-plant operations involving budget maintenance preventive maintenance programs, etc. for process industry. Will be indoctrinated in company's policy for about two years in Chicago then assigned to a district as area maintenance supervisor. Must have good personality. Employer will negotiate fee. Salary, $9,000-$13,000 a year depending on experience. Chicago. C-8356.

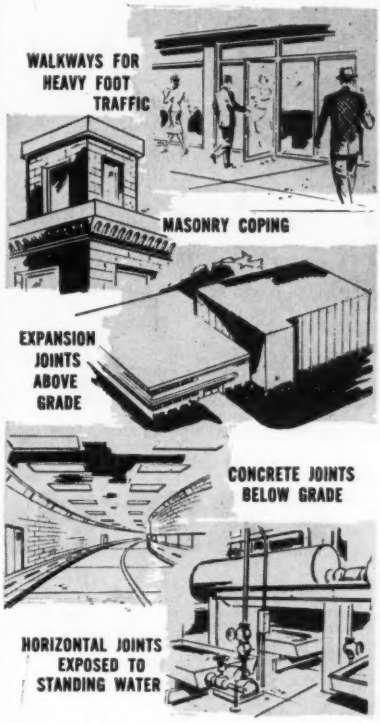
REGIONAL ENGINEERS in Philadelphia, Omaha and Los Angeles doing promotional field work in uses of structural steel. Should be able to discuss design problems encountered in structural steel. Must be interested in promotional work and present subject well. Registered engineers preferred. Salary open, for a trade association. Employee will negotiate placement fee. C-8282.

For POSITIVE Sealing of Horizontal and Vertical Joints

Specify and Use

SERVICISED VERTISEAL®

- Maintains positive bond from below 0°F to 150°F
- No cold flow after cure
- Highly resilient—will not work harden
- Waterproof • Non-Shrinking • Weatherproof
- 3 Types: Pouring, Troweling or Gun Grade


WALKWAYS FOR HEAVY FOOT TRAFFIC
MASONRY COPING
EXPANSION JOINTS ABOVE GRADE
CONCRETE JOINTS BELOW GRADE
HORIZONTAL JOINTS EXPOSED TO STANDING WATER

Servicised Vertiseal is a cold applied, general purpose self-curing joint sealer for positive sealing of horizontal or vertical joints. It is a two-component material manufactured with Thiokol* Polysulfide Liquid Polymers, and is available in widely used standard colors —Gray, Black, and Tan. In addition to its other qualities, Vertiseal is resistant to petroleum derivatives, most common acids, fats, and alkalis. Write for Technical Bulletin and Catalog.

*Thiokol is a registered name of the Thiokol Chemical Corporation

SERVICISED PRODUCTS CORPORATION
6051 W. 65th Street Chicago 38, Illinois

In closing months, 99 trucks ran night and day to reach a goal of 17 million miles over test loops

683 times "around the it's the great

November 30th marked the end of test traffic in the $27,000,000 pavement test sponsored by the American Association of State Highway Officials (AASHO). More than 1,100,000 load applications and hundreds of millions of scientific readings were recorded before the last truck rolled off the track at Ottawa, Illinois. The fleet of trucks—from farm-size pickups to 54-ton semi-trailers—piled up an impressive 17 million miles of travel. On the test loops, 836 separate sections repeat nearly 200 different pavement combinations to provide a wide range of measurements.

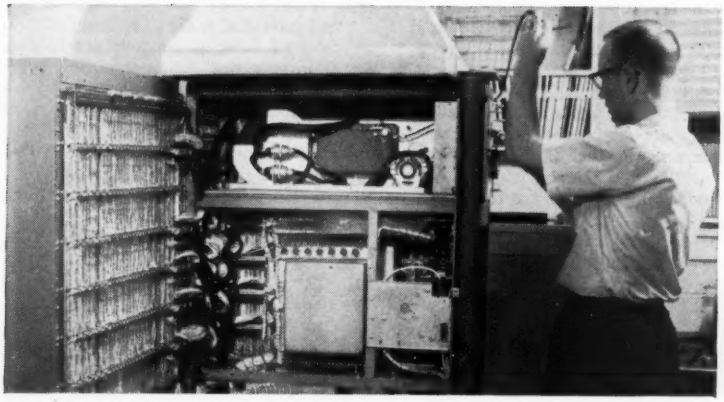
Every effort has been made to carry out the road test by the most scientific methods ever used. Automatic electronic instrumentation and recording equipment was designed to assure unbiased findings of highest reliability. Giant computers are analyzing and evaluating the mountains of statistics accumulated.

Administered by the Highway Research Board of the National Academy of Sciences—National Research Council, the National Road Test will answer the big questions in today's highway construction. The significant findings will influence highway design and construction across the nation.

Engineers, officials and legislators will have invaluable help in designing pavements for the Interstate System—and roads and streets of all classes.

PORTLAND CEMENT ASSOCIATION *A national organization to improve and extend the uses of concrete*

world" in two years... National Road Test!



Scientific readings by the millions have been analyzed by AASHO computers. "Statistically unassailable" facts on pavement design will result.

MOST SIGNIFICANT TEST OF PAVEMENT TYPES OF ALL TIME!

The National Road Test is sponsored by the American Association of State Highway Officials.

Financed by the States and the District of Columbia, the territory of Puerto Rico, the Bureau of Public Roads, the Automobile Manufacturers Association, the American Petroleum Institute, with cooperation and assistance of the Department of Defense.

Administered and directed by the Highway Research Board of the National Academy of Sciences—National Research Council.

Operated by a staff of engineering and technical specialists.

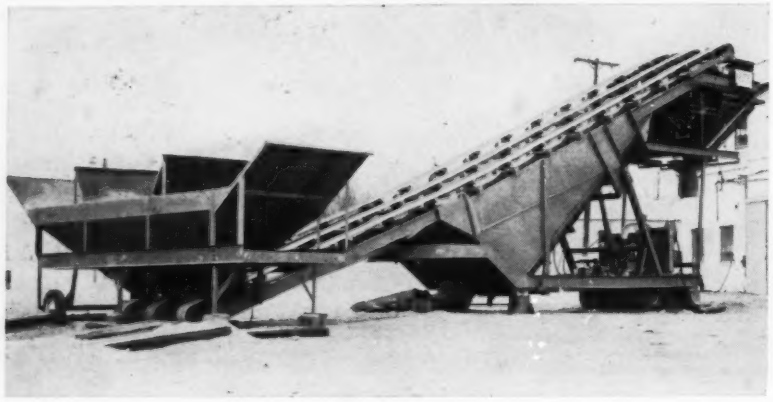
EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Self-Erected Mobile Batching Plant

A MOBILE BATCH PLANT that can be towed to the job at highway speeds and erected in 2¾ hr with only the front-end loader needed to service the plant is now offered by Heltzel. It comes in four sizes with capacities ranging up to 330 cu yd of concrete per hour. One unit is especially planned for central-mix plant operation with one or two 3 cu yd mixers. Some set-ups permit one-stop truck charging. All units have 350 bbl cement storage and can be arranged for delivery of three separate aggregates. Fully-or semi-automatic weigh batching assures meeting all specifications.

The aggregate storage unit is wheel-mounted and available with either two or three compartments. Capacity is 54 tons at 7 ft 10 in. loading height or 75 tons if set-up for higher loading reach is available. Cement storage is built into the batcher unit along with all controls and self-raising hydraulic jacks. A screw conveyor takes cement from bag or bulk delivery, recirculates it and charges the weigh batcher. The only outside requirement is connections to electricity and water. The basic units are the same for all models with variation in type and size of batchers, the number of conveyors and the like. **The Heltzel Steel Form and Iron Co., CE-3, Warren, Ohio.**



Self-erecting

Thermostatic Control

AN AUTOMATIC FAN DRIVE for heavy-duty V-8 truck engines has been developed, consisting of an electro-magnetic clutch located behind the fan. It is activated by a highly sensitive thermostatic control located in the coolant stream. This control is pre-set to engage and disengage the clutch between desired engine operating temperature limits. When the coolant temperature reaches the maximum desired point, automatic engaging of the clutch results in normal fan operation. When the coolant temperature drops to normal, the fan becomes free wheeling again. This frees as much as 12 per cent of usable engine hp. In addition to fuel savings, automatic fan drive aids in easier engine starting, quicker warm-ups, longer belt life, better vehicle heating and substantial noise reduction. **Consumer Relations Dept., International Harvester Co., CE-3, 180 N. Michigan Ave., Chicago 1, Ill.**

Engineer's Level

DESIGNED FOR EFFICIENCY, accuracy and convenience in general engineering work, such as roads, bridges, construction and tunnels, is the N-2 Engineer's Level. An exclusive feature is the telescope, which together with the level vial assembly, can be rotated about the optical axis for checking level adjustments quickly. Other features include a 24 or 28-power telescope with coated lenses, internal focusing, clamp and tangent screw, tilting screw with leverage, and coincidence-reading tubular level. **Wild Heerbrugg Instruments, Inc., CE-3, Port Washington, N.Y.**

Motor Pulley Drives

DESIGNED FOR SIMPLE, economical and dependable operation, variable speed motor pulley drives are now available in ratings of from 1 to 15 hp. Output speeds range from 2200 rpm to 141 rpm with a 3:1 speed variation utilizing 1750 rpm or 1160 rpm motors. Incorporating the efficient power transmission of V to V drive and a simple motor pulley design, these new drives provide reliable power transmission combined with max hp capacity. Applications include utilization with centrifugal pumps, presses, hoppers and shakers, food processing machinery, and many other types of equipment. **Sterling Electric Motors, Inc., CE-3, 5401 Telegraph Road, Los Angeles 22, Calif.**

Sound Survey Meter

THIS HIGHLY ACCURATE, inexpensive sound survey meter is miniature in size, rugged and stable in performance due to its fully transistorized circuitry, and can be used with its matched pick-up as a vibration meter. The hand-held instrument was designed especially for measuring noise levels in factories, offices, public buildings, and in field surveys. It assists in locating the source of potentially harmful sound levels and in the design of quieter electromechanical equipment. Designated the Sound Survey Meter (Type B), it indicates sound pressure levels from 40 to 125 db on its large, legible scale, and has a frequency response well within the A.S.A.-specified tolerances in the 45 to 8000 cps spectrum. Its high fidelity, moving coil and dynamic microphone are unaffected by temperature and humidity changes over the normal range of room conditions. Designed for one-hand operation, it weighs only one pound (with battery), and features click-action, knurled, fingertip controls for both the attenuator and the A.S.A. filter network selectors. **The Korfund Co., Inc., CE-3, 23B Cantiague Road, Westbury, L. I., N. Y.**

Special Tires

THE FIVE-FOOT HIGH tires being used by the U.S. Army Corps of Engineers in placing unusual retaining walls along the banks of the Mississippi River to prevent soil erosion, were specially designed for a "mat puller," which drags jointed concrete mattresses up the river bank from a barge near the shore. The mattresses, formed by joining 20 concrete blocks together in a section, and connecting several sections, were 140-ft wide and 350 to 500-ft long. Wire fabrics imbedded in the blocks link them together as a flexible unit, and permit the mattresses to easily conform to the contour of the river bank. Rubber tires were needed because the engineers decided the mattresses had to be placed higher on the river bank than originally planned. They devised a dolly to which a mattress could be attached by cables. The dolly, or "mat puller," was then winched up the slopes, pulling the mattress with it. **The Firestone Tire & Rubber Co., CE-3, 1200 Firestone Parkway, Akron 17, Ohio.**

Auxiliary Unit

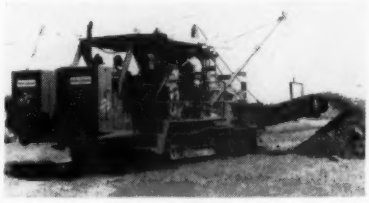
AN AUXILIARY POWER SUPPLY unit for use with a gamma radiation area monitor has been announced. The monitors are used as an automatic alarm system in any area where gamma radiation is present from stored or processed fissionable materials. Designated as Model PSA-11, the auxiliary supplies power to the GA-2 gamma monitor in the event of failure in the primary 110-v source. It is said to provide power for a minimum of 8 hr without recharging. It is a wet cell system with built-in battery charger. Once the primary power source is restored, it begins to recharge automatically. **Nuclear Measurements Corp., CE-3, 2460 N. Arlington Ave., Indianapolis 18, Indiana.**

Hydraulic Excavator

THREE NEW BACKFILL BLADES for the Hopto hydraulic excavator Series 500, 200 and 110 Snap-Mount, are announced by The Warner & Swasey Company. The blades range in size from eight feet, weighing 490 pounds, down to four feet, weighing 130 pounds. They are designed to fasten onto the excavating bucket, and the change from excavating to the backfilling operation can be accomplished in less time required to change one attachment to another. **The Warner & Swasey Company, Badger Division, CE-3, Winona, Minnesota.**

Ditcher

DESIGNED FOR HEAVY-DUTY cross-country pipeline work, the Model 777 full-crawler wheel ditcher digs 54-in. wide and 8-ft. 6-in. deep. The trench width at the top may be increased to 9 ft or more through the use of slopers. Features of the unit include: 40% more hp than with similar machines and independent full-hydraulic drive to each track. Dual-range "Hydra-Crowd" gives the operator full time power steering and one-lever control while digging on the straight-away, permitting an infinite range of crowding speeds from zero to 33 fpm, and allowing the machine to turn around within its own length when maneuvering into or out of position.



Model 777

The unit can mount or dismount under its own power from a conventional low-boy trailer, and requires no dismantling for transport. Crawlers are mounted on a special three-point suspension and can be extended, outboard from their normal positions to provide greater lateral stability and to accommodate wider than normal crawler pads where additional flotation is needed. **Barber-Greene Co., CE-3, 400 No. Highland Ave., Aurora, Ill.**

Two-Way Radio

THE DUO-COM portable two-way radio outdates hand signals, insuring the greatest of surveying accuracy. This 20-ounce power pack can give you direct verbal communication with your rod-man. In sight or not, it doesn't matter, the range of this completely transistorized package is up to 10 miles. It uses eight miniature penlight batteries having a life of up to 50 hr. The case is made of high impact plastic, and the batteries are enclosed in their own leak-proof case. You can use this portable radio for any surveying work where communication is essential, such as when laying out quadrilaterals or running preliminary center lines. A special antenna jack adds versatility by permitting both fixed and mobile communication. You don't need a license or permit to operate this radio, because its frequency is the 27 megacycle range, commonly called the "citizen band." **The Geodimeter Co., AGA Corp. of America, CE-3, 2013 Park Ave., South Plainfield, N.J.**

NOW...one man can splice Rubber Waterstop in just SIX minutes!

To splice Gates new Kwik-Seal Rubber Waterstop in the field, all you need is a small splicing kit and a simple clamping device. This eliminates the need for a field vulcanizer, molded parts, a power supply or heat.

One man makes this strong, permanent splice in just 6 minutes—5 times faster than with former methods!

The Gates Kwik-Seal splice is a chemical bond. The strength of the bond often exceeds the strength even of the rubber—far stronger than government requirements. The waterstop can be handled and placed into concrete forms immediately after splicing.

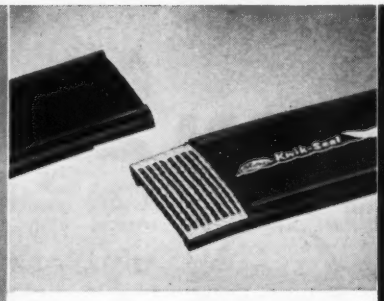
As a result, this new Gates splicing method cuts labor costs and speeds the job.

Write for CATALOG and free splicing demonstration.

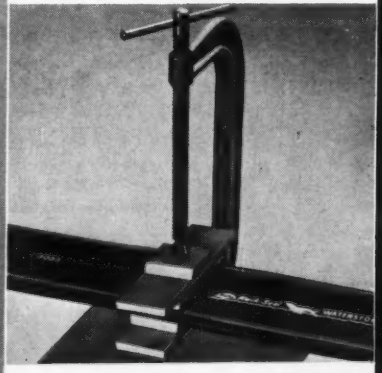
The Gates Rubber Co. Sales Division, Inc. Denver 17, Colorado

Gates Rubber of Canada Ltd. • Brantford, Ontario

BP-31 *Building the Future on 50 Years of Progress* Gates



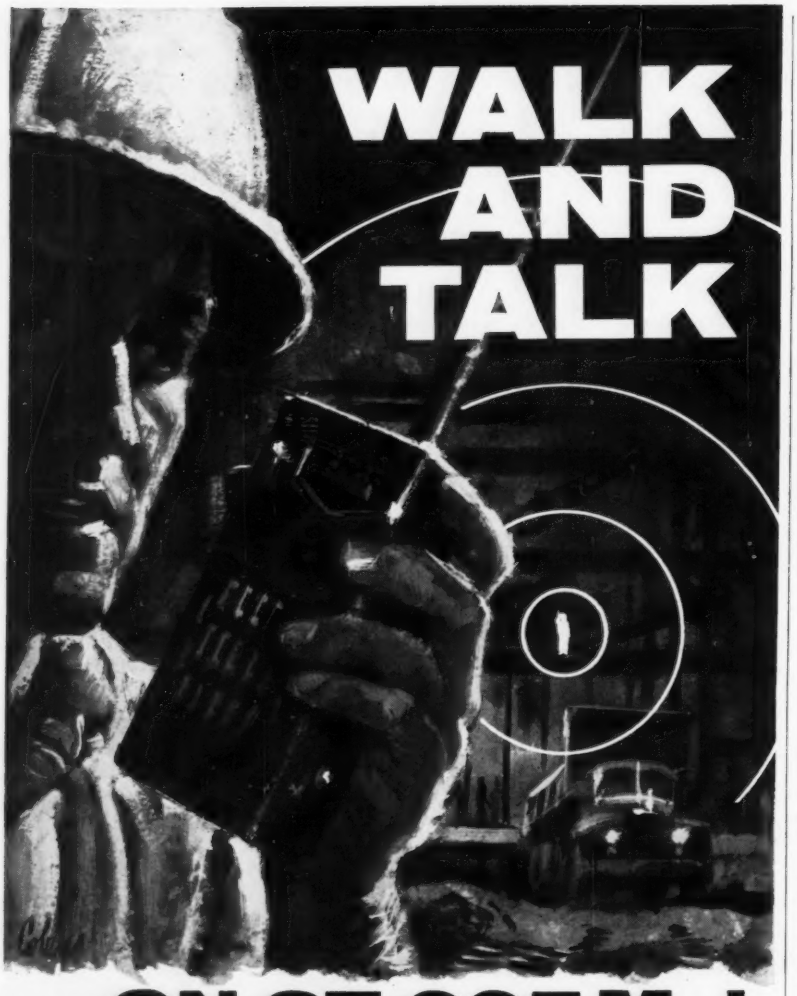
1 Apply Kwik-Kem bonding chemical to prepared surface.



2 Clamp Waterstop firmly for 5 to 6 minutes . . . *and it's spliced.*

SEE OUR CATALOG IN SWEET'S

Gates Kwik-Seal Waterstop



...ON 27.005 Mc!

A new concept in team-work! Pocketsize "Walk 'N Talk" 2-way radio erases delays before they begin. Instant contact anywhere on the job guarantees increased production per man-hour . . . guarantees substantial overall savings.

Start using a "Walk 'N Talk" direct, portable communications system now!

- Operates over, under, through and around buildings
- Earpiece cuts out construction noises
- Range up to 5 miles under favorable conditions
- Handy metal belt-clip
- Weighs only 18-oz., measures a tiny 6½x3x1½"
- AC adapter jack
- No license needed
- Low initial cost
- Switches to a regular transistor AM radio for news, weather, etc.

Full purchase price promptly refunded if returned undamaged within 10 days

Please send me ☐ Set of 2 $139.90 ☐ 1 only $69.95
☐ Money Order Encl. ☐ Check Encl.
☐ C.O.D. (I agree to pay postage)

NAME _____

ADDRESS _____

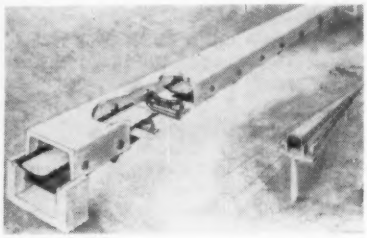
DORSAL ELECTRONICS CITY _____ ZONE ____ STATE _____
1412 B'WAY • NEW YORK CITY N. Y.

EQUIPMENT MATERIALS and METHODS

(continued)

Prestressed Concrete

THE FRANK J. MADISON CO. has developed a materials handling system that



New Conveyer Design

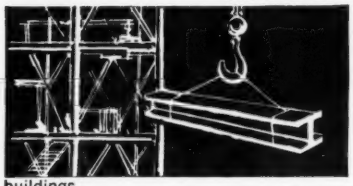
uses prestressed concrete channels as the conveyer support. The U-shaped beams are inverted so as to also serve as a protective cover for the belt, drive, idlers and the material being handled. Inserts for idler attachment are integrally cast in the channels, eliminating the need for steel hangers. Supporting piers and change-overs may be pre-cast or cast-in-place and no steel structurals are required. Maintenance costs are lowered, due to the concrete's inherent freedom from weathering and to the ease of servicing made possible by inspection ports at each idler. Permanence in any environment may be expected from the design, the use of concrete being especially advantageous near the sea and in other corrosive atmospheres. **Frank J. Madison Co., CE-3, 607 Market Street, San Francisco 5, California.**

Fast-Drying Primer

IN ITS FIRST "over-the-ditch" pipeline application, this fast-drying primer is credited with saving time and manpower. It dries in a matter of minutes, as opposed to the normal 3 to 4 hr drying period of conventional primers. This makes it possible to run cleaning-priming and coating-wrapping virtually together, resulting in easier and more effective supervision, elimination of some manpower, and a smoother operation. The primer also provides a bond that is as much as five times stronger than conventional primers, according to the manufacturers. Bitumastic Jet-Set, as it is called, consists of synthetic resins and solvents blended to produce a liquid coating which may be applied cold by brushing or spraying. Coverage of 20-in. pipe averages 700 sq ft per gallon as opposed to 400 sq ft by conventional primers on the same kind of pipe. **Koppers Co., Tar Products Div., CE-3, Koppers Bldg., Pittsburgh, Pa.**

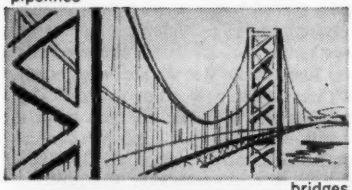
highways

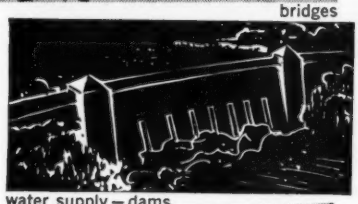
rivers & harbors

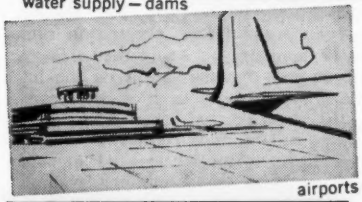

buildings

waste treatment

pipelines


bridges


water supply – dams


airports

industrial plants

WHY ADVERTISING IN CIVIL ENGINEERING STIMULATES SALES IN CONSTRUCTION MARKETS

In the construction industry, four major groups account for nearly all product buying and specifying:

CONSULTANTS ■ CONTRACTORS ■ PUBLIC WORKS ■ OWNERS

Civil engineers occupy key positions in each group. Not only are they responsible for design, construction, operation and maintenance "in the field"... civil engineers are also a primary influence "behind the desk," in charge of management.

As a result of this wide responsibility, civil engineers largely control the specification and purchase of construction equipment, materials and services.

The only magazine edited exclusively to serve the technical, business and professional needs of this select audience is CIVIL ENGINEERING ... official publication of the American Society of Civil Engineers.

Year after year, its circulation has increased with construction activity and the growth of the civil engineering profession. Editorially CIVIL ENGINEERING serves all areas of construction and all civil engineering interests – making it truly The Magazine of Engineered Construction.

Basic data on the civil engineer's role in different construction industry groups is being furnished by A.S.C.E. Mail Forum surveys. For example, the most recent study (of consulting engineers) revealed these facts:

■ CIVIL ENGINEERING's consultant readers own or work for firms that concentrate almost entirely on *engineered construction* projects...with their work divided among the various types of construction as follows:

Airports	3.8%	Military sites	3.9%
Bridges	7.6	Pipe lines	4.6
Buildings, commercial & residential	17.9	Rivers & harbors	1.6
Dams	2.7	Waste treatment	10.9
Highways & streets	14.6	Water supply	10.1
Industrial plants	9.1	Miscellaneous	13.2

■ the average annual cost of all the equipment and materials specified by each of the 290 firms reported is well over $6 million.

■ 90% of the readers influence the purchase and the specification of construction materials, installed equipment and office equipment.

■ their titles and functions are proof of a high degree of authority and a wide area of buying influence within their firms.

In CIVIL ENGINEERING, *advertisers reach top quality consultants concerned only with construction. This is the core of your consulting engineer market ... the men who specify your products!*

And remember... whether your product is specified and purchased through consultants, contractors, architects, owners, public works officials (or any combination of these groups) you get the *most effective, most economical* coverage of civil engineers by advertising in CIVIL ENGINEERING Magazine.

Quality circulation guarantees that your product message will be concentrated on men who make the decisions that lead to purchases!... which is why we say, "advertising in CIVIL ENGINEERING stimulates sales in construction markets."

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

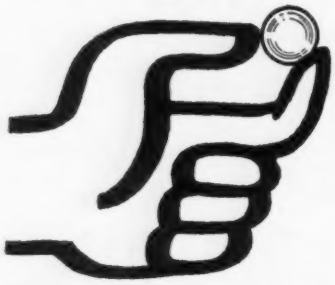
ABC 45,000

CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION

The American Society of Civil Engineers ■ 33 W. 39th St., New York, N. Y.

DOWN TO FUNDAMENTALS



MINIMUM SIZE... MAXIMUM ACCURACY

KERN instruments are of basic, functional design...all indispensable elements compressed into the smallest size and weight possible. At the same time, these rugged, lightweight, highly portable instruments are designed to afford maximum operational precision with effortless ease.

PROMPT, RELIABLE SERVICE
FACTORY TRAINED TECHNICIANS

KERN INSTRUMENTS, INC.
FUNDAMENTAL SURVEYING EQUIPMENT
120 Grand St., White Plains, N.Y.

DKM1 Ten Second Theodolite (with optical micrometer)

for land surveying, triangulation, big construction and engineering operations spot checking.

- *20x telescope. AR coated optics.*
- *Each reading is the arithmetic mean of two diametrically opposed points of the circle.*
- *Fast direct reading to 10 sec. Estimation to 1 sec.*
- *Average working accuracy—3-4 sec.*
- *Only 6 lbs. 7" high, incl. case.*

Write for Brochure K603

EQUIPMENT, MATERIALS and METHODS

(continued)

New Improved Crane

DYNAMIC LOAD CONTROL is part of Manitowoc's newly-improved Model 3900 Crane. Among the many new features is the lightweight "inverted angle" boom; the 3-piece counterweight self-removed by the machine; retractable high gantry, easily raised or lowered by the boom hoist; automatic clutch throw-out limit stop for safe, close radius booming; independent boom hoist with air controls for greater handling precision; and independent swing which allows operator to boom, swing, and travel simultaneously. Compact dimensions of the crane provide for easy shipment. **Manitowoc Engineering Corp., CE-3, Manitowoc, Wisconsin.**

Model 3900

Drawing Instrument

A NEW TEMPLATE designed for isometric pipe drawings has been patented by a graduate engineer. This simple tool enables standardized isometric drawings to be made of all pipe layout sketches. Because of its simplicity, even beginners can make professional drawings the first time. Features include: pocket size, cutouts for most common fitting symbols, laminated clear plastic, rounded corners for uniform angles, and handy compass orientation points. **Wally Verrett, Dept. 4-141, CE-3, P.O. Box 3144, Port Arthur, Texas.**

Plugs and Receptacles

EXPLOSIONPROOF plugs and receptacles for safe, rapid connection and disconnection of permanent or portable electric lighting and power distribution systems in hazardous areas have been introduced. Approved by the U.S. Navy for areas where Saran plastics work is being done, the new "Industriline" plugs and receptacles may be used with 2, 3, or 4-wire circuits rated as high as 240 v, 15 amps or 120 v, 30 amps. Plug and receptacle contacts of electrical-grade copper are solidly encased in neoprene bodies. When the plug is inserted into the receptacle, a lip on the former snugly fits a collar on the latter to form a sealed chamber, preventing the possibility of a spark igniting an explosive atmosphere. Only after this chamber is closed can the plug be turned to engage the contacts and complete the circuit. **J.B. Nottingham & Co., Inc., CE-3, 441 Lexington Ave., New York 17, N.Y.**

Mobile Chemical Processes Monitor

A DATA ACQUISITION and computing system for monitoring chemical process performance has been developed. The new system, incorporating a PB 250 digital computer, provides on-site data processing capabilities not previously available in mobile equipment. It accepts analog data from up to 60 sources, converting it to digital form for computation by the PB 250. The resultant information is then recorded on magnetic tape. The system can energize alarms, make logical decisions, and provide information for a logging typewriter or a paper tape punch. The system can be provided with a battery power supply for operation where no AC power line is readily available or for emergency use during power line failures. The battery supply is trickle charged from a conventional 110 v AC power source. **Packard Bell Computer, CE-3, 1905 Armacost Ave., Los Angeles 25, Calif.**

Concrete Core Drill

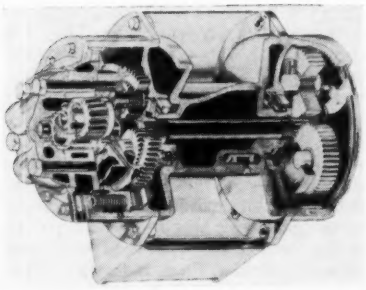
CLEAN HOLES FROM 1 to 10 in. dia. can be drilled vertically or horizontally in reinforced concrete with this heavy duty portable concrete core drill. The unit features four readily changed spindle speeds (500, 1000, 1500, 2500 rpm), to produce the fastest penetration rate for the diameter bit being used. Heavy pressure may be maintained on the bit with minimum operator effort by means of a ball bearing feed screw. The sturdy machine can be moved easily by means of its large swivel wheels and quickly stabilized with the built-in levelling screws. It is easily positioned on its side for drilling through walls by using four pipe legs which attach to clamps provided on the frame. Designated as model K-500 "Versadrill," it is powered by a 5 hp electric motor, 3 phase, 220/440 v. The complete machine, of cast aluminum and steel construction, is compact and weighs just 275 lb. **The Kor-It Co., Inc., CE-3, 991 Richard Ave., Santa Clara, Calif.**

EQUIPMENT MATERIALS and METHODS

(continued)

Up to 22,000 Lbs. Pull

GEARMATIC CO. LTD. has a new hydraulic winch offering: hydraulic drive, which eliminates most of the problems encountered with close-coupled winches; compactness, with the unit connected up by flexible hose it can be mounted high or low, and at the correct angle for most efficient operation; simple one-hand control, with forward and reverse speed controlled from 0-maximum under all load conditions; high-speed reverse, offering from 0-5.25 times forward speed, with optional automatic reversing device; automatic braking, actuated by pressure change; planetary gear design for quiet, efficient operation; cartridge type hydraulic motor and gear train assemblies. **Young & Ross, Adv. Ltd., CE-3, 326 West Pender Street, Vancouver 3, B. C.**



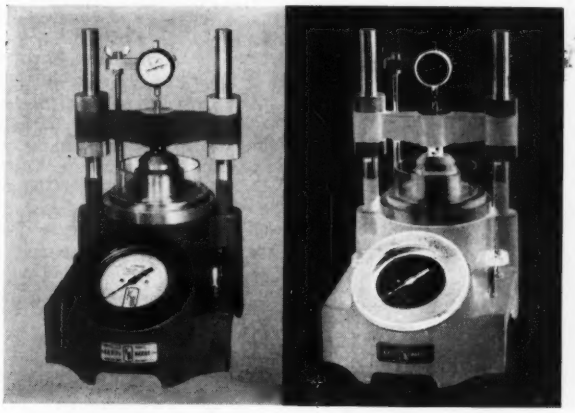
New Hydraulic Winch

Memory Finger

THE MEMORY FINGERS are featured on a line of torque wrenches manufactured by P. A. Sturtevant Company, Addison, Illinois. The device is one of several used to obtain peak readings on compression, tension and torsion load in tests as well as to facilitate tightening fasteners to torque specifications.

In a typical situation, a fastener manufacturer or inspecting department in a firm receiving fasteners makes periodic determinations of the maximum torque which a bolt, nut, screw, or other type fastener will take before its elastic limit is reached and the fastener yields or snaps. Operating a torque wrench with the new indicator is now simplified to the extent that pressure may be applied continuously until a peak is reached without reference to the scale—the reading being postponed until the conclusion of the operation. In the spring compression tests the operator makes use of indicators mounted on opposing sides of the scale, aligning one finger with the other at specified settings. **Raymond J. McGlew, Product Information Service, Public Relations Department, CE-3, Wilmington, Delaware.**

Put This Portable Soil Tester To Work Anywhere!



On the job site, or in the lab, you can easily determine precise rate and amount of soil settlement under any load to 145 TSF with a K-W Conbel. This compact consolidation soil tester gives you infinite choice of no-shock loads maintained indefinitely by automatically regulated air pressure . . . no dead weights or bulky lever arms. Write today for Bulletin 50-A, Tinius Olsen Testing Machine Company.

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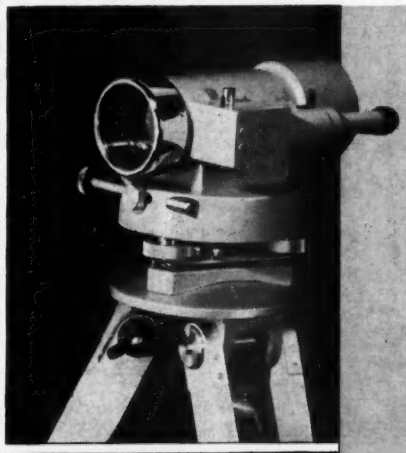

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(continued)

Welders

THREE NEW ENGINE DRIVEN welders, which provide rugged and dependable service while requiring only a minimum of maintenance, have been placed on the market. The first, a 225 amp AC-DC engine driven welder, can handle stick electrode welding, Heliwelding and Aircomatic welding. The power source supplies from 15 to 265 amps DC and 25 to 320 amps AC. The machine is designed for jobs where dependability is essential, and can be utilized as an AC power plant for applications other than welding. The second, the "Yellow Jacket," has been designed in 300 and 400 amp rated sizes and is powered by a 4-cylinder, 4-cycle injection type diesel engine, for service on pipeline and other heavy-duty construction jobs. Steady current is assured even when welding above the generator rating. It features quick response to arc starts, controlled current peaks, and high recovery voltage. The third, rated at 250 amps and utilizing a 4-cycle, 3-cylinder direct injection type diesel engine, is available either as a DC welder/AC power plant or solely as a DC welder. These models are recommended wherever rough usage is encountered in welding and the use of diesel fuel practically eliminates the danger of fire hazard. **Air Reduction Sales Co., a div. of Air Reduction Co., Inc., CE-3, 150 East 42nd St., New York 17, N.Y.**

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Cement Bins

RECTANGULAR IN DESIGN, these mobile ground storage cement bins are offered in capacities of 465, 555 and 645 bbls. All models are built with a heavy duty fifth wheel to fit any standard tractor and truck, and a complete rear axle assembly with standard air brakes and 10 in. x 20.00, 12 ply truck tires. They are also equipped with stop lights, tail lights, turn signals, and standard trailer reflectors. Each unit is completely equipped with all standard bin accessories, such as access hatch, inside ladder, emergency slide gate, bin-flow pads, discharge valve, and air delivery intake unit. It can be installed in any existing cement batching set-up and will appeal particularly to paving contractors who need additional storage capacities. **Clark Industries, CE-3, 375 East Fifth Ave., Columbus 1, Ohio.**

Mobile Units

Plywood Clip

TIMBER ENGINEERING COMPANY has a new supporting clip for plywood decking, called Teco H-Clip. The product is available for 3/8", 1/2", 5/8" and 3/4" plywood thicknesses. They are designed to provide a tight, snug fit. A special feature is a "leveling arm" which adjoins twin supporting tongues projecting from the center of the clip. This "arm" insures easy installation of the clip regardless of any variations that may exist in plywood thicknesses. These clips are laboratory tested and meet FHA Minimum Property Requirements as substitutes for solid blocking. **Timber Engineering Company, CE-3, 1319 18th Street, N. W., Washington 6, D.C.**

High Speed Steel

DESIGNATED REX 49, a new grade of high speed steel has been developed to provide greatly increased tool life in machining hard-to-cut metals. The steel is undergoing exhaustive evaluation in production use to confirm the preliminary laboratory and field tests. It promises to be an outstanding composition for tools designed to cut such materials as highly alloyed steels at high hardness levels, stainless steels, super alloys and titanium. **Crucible Steel Co. of America, CE-3, Pittsburgh 22, Pa.**

Integrated Unit

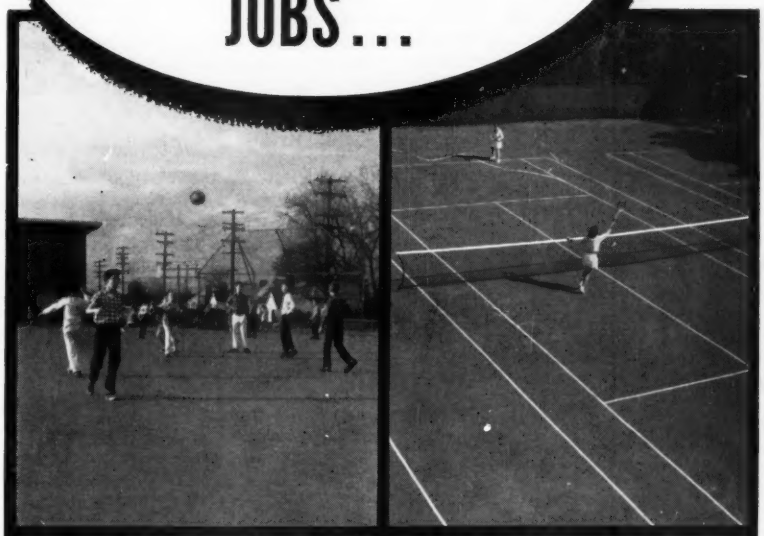
THE "DYNAHOE" IS a new kind of loader-tractor-backhoe, constructed as one integrated unit instead of being a tractor with backhoe and loader attachments. It has an extra heavy frame, buckets, booms, dipper and other components. In addition to easy operation and good visibility for both backhoe and loader controls, advantages of this machine include: adequate tire flotation, proper weight distribution, forward and reverse power-shift, torque converter, power steering, heat exchangers for the hydraulic systems, planetary rear axle, and a swivel operator's seat. The struck capacities are: 7.5 cu ft on the backhoe and ⅞ cu yd on the loader. **The Hy-Dynamic Co., CE-3, Lake Bluff, Ill.**

Loader-Tractor-Backhoe

Cable-Laying Attachment

DESIGNED TO LAY telephone or power cable, plastic, copper or aluminum pipe and conduit without trenching, a new line of cable-laying attachments for all popular makes of heavy duty crawler tractors is now on the market. A special cable-laying shank mounted on the tool beam of the ripper opens up a cut and buries the cable or pipe in one continuous operation. Shanks for burial depths to 72 in. are available. As a usual practice, one or two passes with the standard ripper shank are made ahead of the cable-laying pass, depending on soil conditions. Completion rates of 4 mi per day have been achieved where operations are not frequently interrupted by highway, railroad, pipeline or river crossings. **American Tractor Equipment Corp., CE-3, 9131 San Leandro Blvd., Oakland 3, Calif.**

For those
SPECIAL SURFACING
JOBS...



WALK-TOP
FOR SMOOTH, RESILIENT PLAYGROUNDS

Modern design specifications for schoolyards and other play areas call for surfacing that is smooth, non-abrasive and resilient; yet tough and highly resistant to wear and weather. Walk-Top®, a special factory-compounded asphalt emulsion, meets all these requirements. In Los Angeles, alone, more than 5 million sq. ft. of playgrounds have been surfaced with Walk-Top!

LAYKOLD
FOR THE FINEST IN ALL-WEATHER TENNIS COURTS

Laykold® tennis courts provide year-around, maintenance-free playability. More than 10,000 Laykold courts are now in play throughout the world. These true-plane, resilient courts are available in black, red or green; or in the new "two-tone" combinations of colors. Laykold courts were recently selected for installation at Forest Hills, as shown above.

PLAY YARDS AND TENNIS COURTS are only two examples of *special jobs* that require not only *special materials* but also *special construtions methods.*

In developing Walk-Top and Laykold, (plus a broad line of other asphalt specialties) we have also pioneered and developed specifications covering proper construction and application practices. These "specs" are available without charge to architects, engineers, contractors or to anyone concerned with special surfacing jobs.

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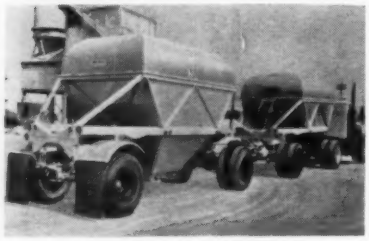
Bottom Dump Trailer Trains

CONSTRUCTED OF SPECIAL ALLOY ALUMINUM and light, high-tensile steel truss, these new, improved dump trailer trains have been engineered especially for over-the-road hauling. The truss and hopper are built as an integral unit to offer maximum strength and lightest over-all weight. The Model LWC-2 is built expressly for hauling bulk cement, and the LWB-1A is for hauling dry, bulk, flowable materials such as sugar, fertilizers, grains, chemicals, etc. Engineered to be the lightest hauling equipment of their kind on the road, each has a full 28 ton payload capacity, with the highest ratio of payload to gross load. Equipped with double-acting butterfly gates, the LWC-2 can also be used for hauling aggregate and makes an ideal rig for service to ready mix concrete plants. **Challenge-Cook Bros., Inc., Dept. 13, CE-3, 3334 San Fernando Road, Los Angeles 65, Calif.**



Lightweight

Bridge Maintenance

THE TREATMENT of coating the roadway areas of the bridges is done with epoxy resin, an unusual material that adheres to the concrete surface and seals it against salt and water penetration, thereby protecting the concrete from deterioration. Emry grit embedded in the coating forms a non-skid surface that provides added safety to high-speed travel.

The Highway Authority chose the epoxy coating because of its great resistance to wear and its ability to withstand expansion and contraction of the concrete without cracking or chipping. It is sprayed on and because it hardens in a matter of hours, traffic lanes can quickly be reopened. The new surface is not expected to show signs of wear for at least five years. Then, where necessary, worn areas can be recoated by the same process. **Union Carbide Plastics Company, CE-3, 270 Park Avenue, New York 17, New York.**

Rolling Platform

COMBINING REMARKABLE LIGHTNESS in weight and utmost flexibility of positioning, this handy new rolling platform is built to boost work output at any height up to 6 ft 1¼ in. Platform supports adjust up or down the ladder frame in 2-in. increments and spring-lock in place. This fine adjustment permits strain-free work at a profitable fast pace. The platform offers a comfortable standing area 6 ft x 2 ft. The scaffold rolls easily through doorways and straddles furniture, steps or building abutments. It dismantles quickly to store flat, yet assembles into a completely rigid, dependably-safe scaffold that takes a concentrated 400-lb load. In use, foot-lock casters keep it absolutely stationary. **Tubular Structures Corp. of America, CE-3, 4560 Sperry St., Los Angeles 39, Calif.**

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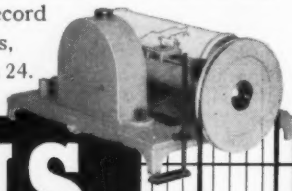

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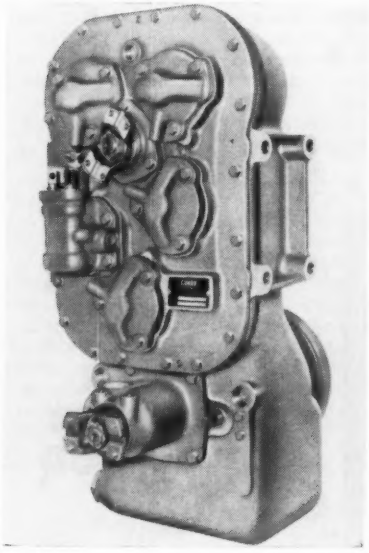
Power-Shift Transmission

DESIGNATED THE 2000 SERIES, a new transmission for off-road vehicles has been designed for use with the 270 series torque converter. It will be used with gasoline or diesel engines of approximately 200 lb ft of torque output. A major feature of its design is a system of four hydraulic clutches that make available two speeds forward and two reverse, fully power shifted. A manual range selector is used, providing for four speeds in each direction. Hydraulic power to operate the clutches is supplied by a pump mounted on the torque converter. Two more pumps may be mounted on it to provide hydraulic power for auxiliary operations. The transmission is adaptable for either two or four wheel drive with output shaft 17 in. below the input shaft. The engine may be located in the front or rear of the vehicle. All four clutch packs are identical for simplified maintenance and four-bolt side mounts are provided for ease in installation and removal. **Clark Equipment Co., Automotive Div., CE-3, Jackson, Mich.**



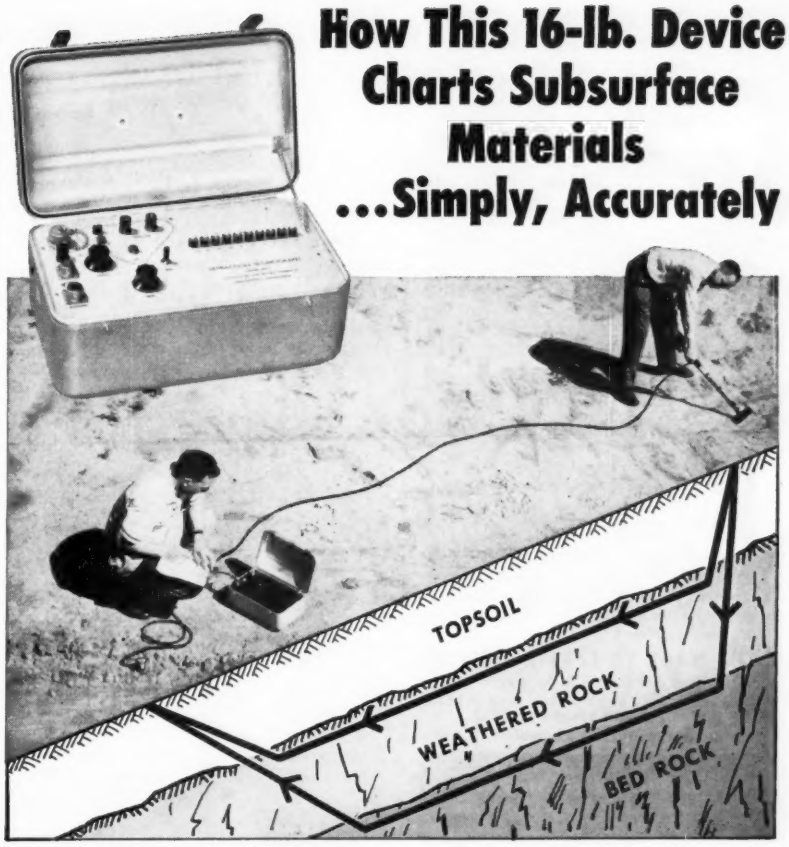
2000 Series

Backhoe

HYDRAULIC MACHINERY'S CRAWLER BACKHOE, MODEL 480, powered by a 70 hp, six cylinder gasoline engine, has a 360° swing, digging depth of 15′, reach 23′ and a dump height (closed) of 12′ 6″. Unit can climb grades of 30% at top speed of 1.5 mph.

Three pump hydraulic system enables operator to work both boom and bucket while swinging. Crawler motion is controlled through double hydraulic motors on each track. Track length is 10′, width 94″ and standard pads 24″ wide. It also features safety-glass equipped all-weather cab, with optional attachments, including frost breaker, ripper, ditch cleaning, bucket, and Hy-jib crane. **Hydraulic Machinery Company, CE-3, 1400 National Avenue, Waukesha, Wisconsin.**

How This 16-lb. Device Charts Subsurface Materials ...Simply, Accurately



That vital first step before you locate a highway or bid an excavation —providing accurate information about depth and type of materials below the surface—is far simpler and less expensive with this proven device, Geophysical's model MD-1* Engineering Seismograph.

It's easily portable, providing immediate information anywhere two men can go. Costly exploration crews and equipment are not required. And data obtained is not limited to single points as in drilling, but can cover the entire area of operation.

HERE'S HOW IT WORKS:

The sledge hammer produces sound waves which travel through the earth. The MD-1 measures the time required for the sound to travel a given distance. This time is determined by the depth and type of the material; the denser the material, the faster the sound waves travel. For example, sound travels slowest through overburden, faster through clay or weathered rock and still faster through solid rock. In this way, the MD-1 can determine single or multiple layers.

See how simply you can obtain your vital subsurface information with this Engineering Seismograph. Operate it yourself after a few minutes simple instructions. Demonstrations are now being scheduled on a regional basis. Write for full details. *Patents pending

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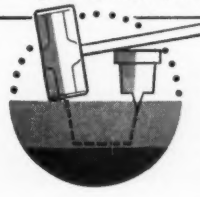

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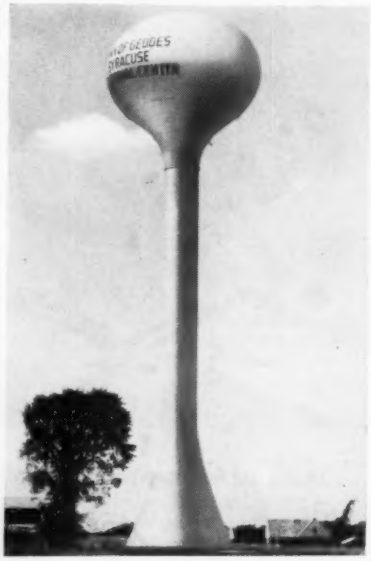
EQUIPMENT, MATERIALS and METHODS

(continued)

Water Tank

A 147-FT ELEVATED water tank, one of the tallest of the pedestal spheroid type in existence, is now in service near Geddes, N.Y. Equal in height to a 14-story building, this 500,000-gal capacity tank was designed to meet current and future water needs of the expanding Syracuse industrial area. It was designed to



14 Stories High

tie in with a 100,000-gal elevated tank in the same area to assure effective pressure equalization. The expanded water system permits the district to welcome new industries. **Pittsburgh-Des Moines Steel Co., CE-3, Neville Island, Pittsburgh 25, Pa.**

Primary Crushing Plants

TWO COMPACT, efficient units are the 4336 and 3026 Single Impeller Impact Breakers with vibrating grizzly feeders. Their simple design and fewer working parts mean less wear and maintenance. They are highly portable with only a minimum of disassembly necessary to meet road weight limits. The 4336 has a capacity of 200 to 400 tons per hr and the 3026 is rated at 150 to 250 tons per hr. The primary crushing plants are ideally suited for use in material with a low silica content and produce a high volume of cubical aggregate with a minimum of slabs, slivers and soft stone.

The material is first reduced by striking whirling impellers and then hurled against a breaker plate and breaker bar for secondary reduction. A vibrating pan feeder, with a tapered-bar grizzly, which by-passes fines and undersize material, is used to feed the material to the breaker. The underslung unit, fully protected against falling rock, keeps the material in constant forward motion, providing a uniform feed rate. **Iowa Manufacturing Co., CE-3, Cedar Rapids, Iowa.**

Three Lift Heights

THE L-812 FORK LIFT is now available with three different lift heights for placing masonry materials on various scaffold levels. The standard production model has a maximum lift of 7 ft 6 in., with alternate lifts offered of 8 ft 6 in. and 6 ft 6 in. These lift heights will accommodate the various scaffold standards established in different sections of the country. Telescoping lift columns are used on the two larger machines, with retracted heights of 5 ft 7 in. and 6 ft 1 in. to clear doorways. The smaller lift employs a one-piece rigid mast that tilts back for doorway clearance. The L-812 will handle two 100-brick packages or 1000 lb at 8-in. load center, or one half pallet of 125 bricks or 800 lb at 12-in. load center. **The Prime-Mover Co., CE-3, Muscatine, Iowa.**

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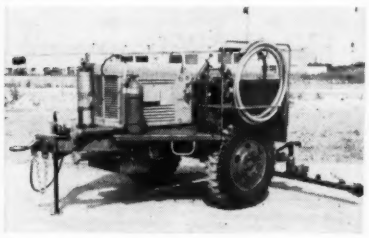
(continued)

Bituminous Distributor

ORIGINALLY DESIGNED TO MEET Army Corps of Engineers requirements, this trailing tankless-type bituminous distributor is ideal for all types of civilian applications. These include asphalt stabilizations and large sealcoating jobs. It is towed by the bituminous supply truck from which the distributor draws its material, and can be towed job-to-job at



Tankless Distributor

super-highway speeds. Since it can be kept working virtually non-stop, the unit is an excellent running mate for the high-speed chip distributors now so popular for sealcoating. On long-mileage jobs, remote from the source of supply, one tankless distributor can handle the material brought in by a fleet of tank trucks. Removal of spray bar, pump, engine, and controls from the tank truck also permits the hauler to carry a larger payload. All the functions of the unit are accomplished by a new master-control valve. **Seaman Corp., CE-3, P. O. Box 3025, Milwaukee 18, Wisc.**

Attachment

THE 88C HYDRO-CLAM is a backhoe attachment for utility tractors designed specifically for spot excavations and digging graves. The new attachment is available with 24, 30 and 36-in. wide buckets, features 10,000-lb breakout, 3,000-lb lift capacity, 12-ft digging depth, and 9-ft

88C Hydro-Clam

9-in. dumping height. The clam bowls operate independently or together to produce smooth, clean sides and a level floor. Their tremendous breakout pressure produces square corners. The entire clam assembly can be attached or detached from the boom in minutes. **Parsons Co., CE-3, Newton, Iowa.**

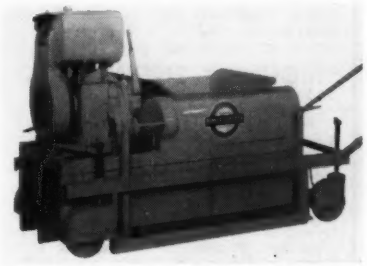
Conversion Hoist Package

THIS OUTSIDE MOUNT, three-stage, duoscopic hoist is recommended for body lengths of 14 to 18 ft. Recommended GVW range for the hoist applied to a single axle chassis is 16,000 to 21,000 lb, for tandem axle, 16,000 to 28,000 lb. Cab-to-axle dimensions of 102 to 120 in. are recommended. Payloads to 18 tons may be carried, depending on chassis and application factors.

Design features of the Model 44371 conversion hoist package include smooth, fast lifting action and an 11-in. mounting height. A total stroke of 71 in. provides a 45-deg dumping angle. A built-in pressure relief valve and bronze wear plates in the pump assure long life with minimum maintenance. **Galion Allsteel Body Co., CE-3, Galion, Ohio.**

Curbing Machine

THE "HIGH CURBER" lays concrete or asphalt curbs from twelve to twenty-four inches high, without the use of forms and can be used to extrude concrete crash barriers as wide as eighteen inches on the base. The speed of the machine is three to five feet per minute depending on the



size of the curb and adjustments in the machine allow it to negotiate contours, move up or down grade, and turn radii down to twelve feet. It is powered by a Wisconsin Model AGND Engine developing 12.2 HP @ 3200 RPM. **Power Curbers, Inc., CE-3, Salisbury, North Carolina.**

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Ask for a demonstration or write for your free copy of Acker Bulletin 27-CE today!

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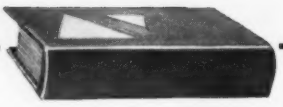

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Literature Available

VAPOR SEAL—A four-page bulletin on Pioneer #1008 Vapor Seal describes the products as a blend of asphalts, petroleum resins, plasticizers, asbestos, mica and solvents. Applied as a coating, it protects against rust, corrosion, abrasion, sunlight and weathering. It can be used on metals—tanks, bridges, siding, etc.—glass, brick, cement, etc.
Data is included on the product's physical properties; a chart for calculating the number of gallons needed to provide specific film thicknesses over unit coverage areas; application procedures; insulation values; etc. **Witco Chemical Company, Inc., CE-3, 122 East 42nd Street, New York 17, New York.**

PIPE THAWING EQUIPMENT—Contained in the bulletin EW-243 is data on the thawing of frozen water pipes with low voltage electricity. Subjects covered are: who needs pipe thawing equipment, electric method, types of equipment, instructions for successful thawing and safety suggestions. Typical pipe thawing connections are illustrated. Tables show amperes and time required for thawing steel pipe, recommended cable sizes and maximum amperage loads. **Hobart Brothers Company, CE-3, Troy, Ohio.**

ELECTRICAL WIRING—A 56-page, illustrated, reference and data manual for builders demonstrates how Robertson Q-Electrical wiring systems for cellular-steel flooring and cellular-strip systems provide unlimited electrical availability for modern buildings.
Specific information includes, roughing-in materials, finish materials, layout design and installation data as well as specifications and dimensional drawings of the Electrical fittings. **H. H. Robertson Co., Q-63, CE-3, Pittsburgh, Pa.**

BUCKET ELEVATORS—A 22-page booklet containing engineering data on various type of bucket elevators and recommending the grades of belting best suited for elevating materials of different weight, abrasiveness, temperature, etc. has just been issued. It deals with belt selection procedures, statistical tables on steel elevator buckets, trouble-shooting, belt splicing, etc. **Hewitt-Robins, Inc., CE-3, 174, 666 Glenbrook Rd., Stamford, Conn.**

SEISMIC SOIL EXPLORATION—A new portable apparatus for seismic investigations to depths of up to 100 ft is described in this paper. The field technique used and the method of calculating the depths of various layers is described. An indication is given of the interpretation of the velocity of sound in different soil and rock formations in terms of their engineering properties. **Texas Instruments Inc., CE-3, 3609 Buffalo Speedway, Houston 6, Texas.**

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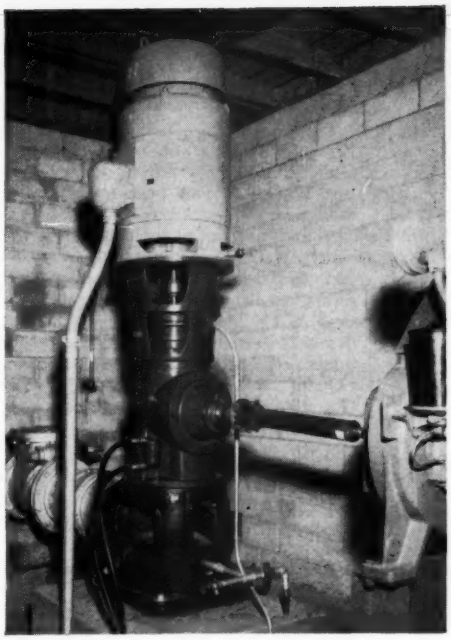
SPECIFICATIONS—Revised and re-written in many important areas, the newly updated metal lathing and furring specifications for this year are now available. Basic design criteria are included for lathing of hollow and solid partitions, ceilings, furring, stucco, plaster reinforcements, columns and other assemblies. Also covered is the use of rib metal lath with portland cement plaster in residential and other types of buildings. **Metal Lath Manufacturers Association, CE-3, Engineers Building, Cleveland 14, Ohio.**

PRIMARY TREATMENT PLANT—A complete technical presentation of the Spirahoff® sewage treatment plant, contained in a single structure, is offered in the 8-page Catalog No. 300. Design data on the compact plants includes detailed engineering drawings with all dimensions, volumes and surface areas. Operation characteristics plus comprehensive technical specifications are also included. A cut-away view of the two-story plant with its settling compartment and digestion chamber shows the entire operating cycle in an easy-to-understand fashion. **Yeomans Brothers Co., CE-3, 1999 North Ruby St., Melrose Park, Ill.**

PERFORATED SUBDRAINAGE PIPE—A catalog describing the advantages of perforated corrugated pipe for subdrainage, illustrates simple installation of perforated pipe and points out that steel pipe requires practically no trenching care, reduces the number of joints, and can be joined with simple band couplers fabricated to fit either helical or straight corrugations. It also describes a new line of wedge fasteners which speed pipe installation and reduce material cost. **Armco Drainage & Metal Products, Inc., CE-3, 9360 Curtis St,. Middletown, Ohio.**

SANDHOG EQUIPMENT—Bulletin No. 23-a illustrates a wide variety of sandhog equipment in use. The colorful 4-page bulletin describes installations of Man Locks, Tunnel Shields, Air Locks and Lock Doors, Grouters and Pea Shooter Cars, as well as many types of Tunnel Cars and allied equipment. The Scott Tunnel Excavator is also illustrated. **Mayo Tunnel & Mine Equipment, CE-3, Lancaster, Pa.**

RUBBER JOINTS—Engineers, contractors, public officials and others concerned with designing, constructing and financing sewerage and drainage systems will find a comprehensive "packet" of information on Tylox Flexible Pipe Joints in a new 16-page manual in color. Five different Gasket designs are described and diagrammed, covering Tylox jointing for concrete Tongue and Groove, Bell and Spigot, Offset and Recessed pipe, and modifications on these. **Hamilton Kent Mfg. Co., CE-3, 427 West Grant St., Kent, Ohio.**



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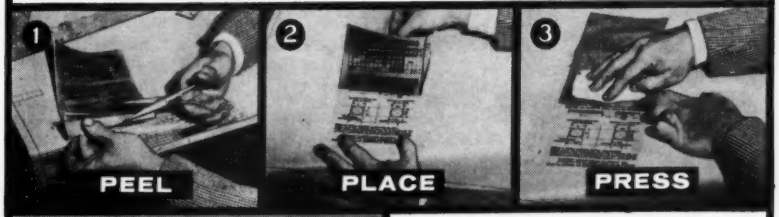

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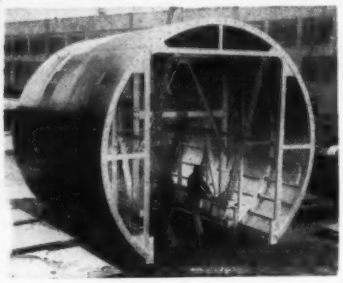
MOVIES AT WORK—a 16mm color and sound production, illustrates the wide range of in-plant films. It demonstrates that the motion picture is a valuable tool in industrial communications; safety instruction; time-motion analysis of specific jobs; slow-motion studies of machine operations to pinpoint trouble spots; training of new employees for assembly operations, etc. The film may be obtained without charge. **Audio-Visual Service, Eastman Kodak Company, CE-3, Rochester 4, New York.**

CONCRETE IN THE '60's—A new motion picture, Report No. 1, has just been released. The film, a continuation of the newsreel series issued annually since 1957, highlights outstanding construction projects, news events and new applications of concrete during the past year. It also includes projects which are now being planned for the future. Sixteen millimeter prints are available on loan. **Portland Cement Association, CE-3, 33 West Grand Avenue, Chicago 10, Illinois.**

BRIDGE TO THE FUTURE—a 16mm, color, sound production which continues the story from the summer of 1958 through the summer of 1960, illustrating the building of the world's highest steel-arch bridge over the Colorado River, the establishment of the community of Page, Colorado and the construction of diversion tunnels. The film is available on loan. **Consumer Relations Department, International Harvester Company, CE-3, 180 North Michigan Ave., Chicago 1, Illinois.**

CONSTRUCTION FILMS RELEASED—The manufacturer of the Gradall and Hopto earth moving machines, now has available through its dealers, five motion pictures showing these lines of construction equipment in action. They are: "Digging For Profits", "Water Conservation", "The Railroad Gradall", "G-1000", and "The Big Decision". All these pictures are 16 millimeter and in color and three of them have sound. **Warner & Swasey Company, CE-3, 5700 Carnegie Avenue, Cleveland, Ohio.**



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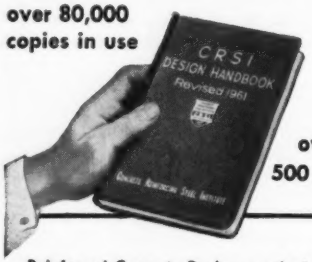

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From the MANUFACTURERS

NEW PRODUCTS: The Allis-Chalmers Mfg. Co., Milwaukee, Wisconsin, has recently developed a fuel cell demonstration kit that produces electricity from chemical reactions and is designed primarily as a teaching aid for secondary schools across the country . . . A "bubble" of VISQUEEN polyethylene film developed by Union Carbide Corp. helped defeat the cold for concrete work. The plastic film was used like a dome to cover poured slabs and it enabled proceeding with home building, etc. despite blustry winter weather . . . Two Ottawa Commando Hydra-Hammer self-propelled pavement breakers were given the job of working over the Anthony Wayne Bridge. Two machines were used; one cutting longitudinally and the other laterally thus saving labor and equipment on the resurfacing operations . . . **CHANGES:** A major change in sales policy, under which all sales of powder actuated stud drivers and related tools will be handled by distributors, has been announced by Gregory Industries, Inc., Lorain, Ohio . . . Toyo Umpanki Co., Ltd. has begun to produce the "Michigan" line of rubber tired construction and earth-moving machinery under license from Clark Equipment Co., Buchanan, Michigan . . . Adoption of a new identifying trademark and standardization of the corporate signature have been announced by Armco Steel Corporation . . . **CONSTRUCTION:** A 630' reinforced concrete chimney will be constructed by The Rust Engineering Company near Clearfield, Pa. . . . December 8th marked the formal opening of the W. S. Dickey Clay Mfg. Co.'s new ultramodern Birmingham-Bessemer plant in Bessemer, Alabama . . . **PURCHASES:** The Drott Manufacturing Corporation of Milwaukee and Wausau announced the purchase of Travelift & Engineering, Inc., Sturgeon Bay, Wisconsin . . . The President of General American Transportation Corp. of Chicago and the President of INFILCO Inc. of Tucson, announced that the Chicago corporation has acquired the outstanding stock of INFILCO Inc. . . . **WARRANTIES:** The warranty on all new Dorsey Trailers sold after January 1, 1961 has been extended to 12 months . . . Factory warranty on all new International trucks has been extended to cover 12,000 miles or 12 months . . . **EXPANSION:** An agreement whereby The Bendix Corporation will market and manufacture diesel fuel injection equipment of Simms Motor Units Ltd., of England, in the United States was announced in Detroit . . . Recently established by the George N. Kahn Company, Inc. was a marketing and selling service for contractors and building materials manufacturers called The Construction Clearing House . . . **AWARDS OFFERED:** Expert motor grader operators, also skilled in use of the Preco Automatic Blade Control, are eligible for achievement awards in view of their contributions to more productive, economical construction, offered by PRECO, Inc. . . . **APPOINTMENTS:** Robert W. Bird has been named assistant to Samuel W. White, Jr., new president of Oliver Corporation . . . The appointment of Mr. A. Blake Cornthwaite of Richmond, Va., as Managing Engineer for the Atlantic-Gulf Division has been announced by Dr. J. E. Buchanan, president of the Asphalt Institute . . . Harry B. Bracey, of the American-Marietta Company, has been appointed to the new post of Marketing Manager . . . Raymond K. Strayer, has been appointed Sales Manager of the Steel Plate Division of Posey Iron Works, Inc. . . . Herbert J. Leib has been named executive vice president, in charge of operations, of Klemp Metal Grating Corporation . . . David J. Champion has been appointed vice president of The Champion Rivet Company . . . U. S. Blue Print Paper Co., Chicago, Ill., announces their appointment as distributors for E. O. Richter & Co. precision drawing instruments . . . **ENTERS NEW FIELD:** The formation of a new company, COMCO Corporation, Philadelphia, Pa., was announced by Gilbert Kerlin, Partner. COMCO Corporation manufactures and markets equipment that incorporates unique and revolutionary design principles for the classification and conveying of materials . . . **SILVER ANNIVERSARY:** Ranney, Inc., of Columbus, Ohio and their many franchise operators announce that they have had their biggest year of business and are celebrating their silver anniversary.

GROUND WATER BASIN MANAGEMENT

The Committee on Ground Water of the Irrigation and Drainage Division has worked for many years to prepare this Manual of Engineering Practice (No. 40). It deals with the operation and management of ground water resources for irrigation and other beneficial uses. Copies of the manual can be obtained by completing the accompanying coupon. The list price is $4.00 and ASCE members are entitled to a 50% discount.

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ASCE MANUAL 37 "Design and Construction of Sanitary and Storm Sewers", issued in early 1960 as a joint effort with the Water Pollution Control Federation has now been reprinted with corrections to several pages. Those who have a copy of the 1960 edition can obtain, with the compliments of the Society, a reprint containing those pages that have been corrected for the 1961 edition. This reprint can be cut apart and the pages inserted into the previous edition.

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January

Journals: Hydraulics, Power, Pipelines, Sanitary Engineering, Structural, Surveying and Mapping.

2725. Discussion of Proceedings Paper 2218, 2256, 2259, 2321, 2441, 2460, 2512, 2545. (ST) Ming L. Pei on 2218. A. L. L. Baker on 2256. Ardis White on 2259. S. L. Lee and F. P. Wiesinger on 2321. R. S. Alwar on 2441. Gordon K. Ray and William G. Westall on 2460. S. O. Asplund on 2512. A. A. Eremin on 2545.

February

Journals: Engineering Mechanics, Pipelines, Soil Mechanics, Structural, Waterways and Harbors.

2726. Small-Boat Development on the Pacific Coast, by Reuben J. Johnson. (WW) Harbor characteristics, federal interest, benefit analysis, construction features, and shoreline considerations are examined with a view toward ultimate development of a chain of small-boat harbors along the coast.

2727. Spherical Waves in a Plastic Locking Medium, by Mario G. Salvadori, Richard Skalak, and Paul Weidlinger. (EM) Asymptotic short-time and long-time solutions are derived in closed form for the spherical wave propagation in an infinite, plastic locking medium.

2728. Vibration of Shear Buildings by Flexibility Method, by Ming L. Pei. (EM) A modified matrix iteration method using the inverse of the stiffness matrix that will obtain the primary vibration frequency of buildings is presented.

2729. Latest Dredging Practice, by Ole P. Erickson. (WW) This paper contains a description of the modern hydraulic dredge and its importance in industry.

2730. Shoaling of the Lower Hudson River, by Charles M. Duke (WW) This paper is a progress report on the investigations being performed by the Corps of Engineers using large hydraulic models at Vicksburg, Mississippi to solve the problem of excessive shoaling in the lower Hudson River below the George Washington Bridge, in New York.

2731. Dynamic Elastic-Plastic Analysis of Structures, by Melvin L. Baron, Hans H. Bleich, and Paul Weidlinger. (EM) This paper presents the finite difference method for the elastic-plastic analysis of structures and a comparison of its results with simpler theories.

2732. Underpinning of a Wind Tunnel, by James F. McNulty and James S. O'Brien. (SM) A new method of reinforcing the foundations of wind tunnels is examined.

2733. Marine Oil Terminal for Rio de Janeiro, Brazil, by H. W. Reeves. (WW) This paper describes the engineering design of the wharf, pipelines, and mechanical equipment of the newly constructed marine oil terminal.

2734. Timber Piles Installed in Permafrost, by Willard C. Jensen. (SM) Data are presented from the construction of a large composite building in permafrost which support the contention that it is no longer necessary to place piles 30 ft deep to assure support in areas where the mean annual temperatures are 22F or lower.

2735. Viscoelastic Plate on a Viscoelastic Foundation, by Karl F. Pister. (EM) Axisymmetric bending of a viscoelastic plate of finite thickness supported by a viscoelastic foundation of infinite extent is examined.

2736. Moire Fringes as a Means of Analyzing Strains, by C. A. Sciammarella and A. J. Durelli. (EM) The objective of this paper is to show the application of moire fringes in the determination of strains in two-dimensional models.

2737. Pipeline Location: As-Built Records, Progress Report of the Task Committee on Pipeline Location of the Pipeline Division. (PL) Regulatory agencies' requirements relative to as-built records are described for natural gas and common carrier pipelines.

INSTRUCTIONS

1. Every ASCE member can be registered in two of the Technical Divisions and receive automatically all papers sponsored by those Divisions. **Such registration will be effective 30 days after the receipt of the registration form.**

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PROCEEDINGS AVAILABLE

2738. Pipeline Location: Engineering Service Agreement, Progress Report of the Task Committee on Pipeline Location of the Pipeline Division. (PL) A model agreement covering most types of engineering-survey services that a pipeline company might expect to obtain from outside organizations is presented.

2739. Pipeline Location: Duties of the Engineer on Construction, Progress Report of the Task Committee on Pipeline Location of the Pipeline Division. (PL) Functions of the engineer on construction are presented.

2740. Pipeline Location: Reconnaissance, Progress Report of the Task Committee on Pipeline Location of the Pipeline Division. (PL) Procedures used in the process of reconnaissance of pipeline locations are reviewed.

2741. Minimum Weight Design of Beams for Deflection, by Ralph L. Barnett. (EM) Design procedures for minimum weight of statically determinate beams are examined.

2742. Tests of Composite Beams with Stud Shear Connectors, by Charles Culver and Robert Coston. (ST) This paper presents the test results of composite concrete-steel beams using L-shaped stud-shear connectors.

2743. Stress Analysis of Translational Shells, by Kristoffer Apeland. (EM) A method of solution of the problem of bending of thin shallow translational shells is presented.

2744. Behavior of Beach Fills in New England, by Harry S. Perdikis. (WW) A study of the behavior of fills placed on ten New England beaches.

2745. Synthetic Material Filters in Coastal Protection, by Hans A. Agerschou. (WW) This paper reviews the possibilities of substituting "synthetic material filters," especially glass fiber and plastic filters, for graded material filters in coastal protective and river structures.

2746. New Method of Consolidation-Coefficient Evaluation, by Ronald F. Scott. (SM) A new method of evaluating the consolidation-coefficient utilizing the ration of compressions is examined.

2747. Design of Fox Point Hurricane Barrier, by Roy S. Martin. (WW) This paper described the Fox Point Hurricane barrier and examines the major design problems caused by tide levels, wave forces, estuary flow, and poor foundation conditions.

2748. Wind-Induced Vibrations in Antenna Members, by William Weaver, Jr. (EM) The results of the wind tunnel are presented for the semi-empirical solution to the problem of wind-induced vibrations in the aluminum tubular members of large radar antenna space frames.

2749. The Great Volga Waterway, by Otakar W. Kabelac. (WW) A survey of the engineering development of the European Volga River from unregulated natural conditions into a modern waterway system is presented.

2750. Discussion of Proceedings Paper 2168, 2173, 2177, 2301, 2507, 2590. (WW) R. Silvester on 2168. H. A. Einstein and Jones A. Harder on 2173. J. W. Johnson on 2177. P. Brun and F. Gerritsen on 2301. Charles E. Lee, Robert L. Miller on 2507. Shoshichiro Nagai, A. S. Kahan on 2590.

2151. Discussion of Proceedings Paper 2198, 2505, 2575, 2578, 2615, 2627. (EM) Aris Phillips on 2198. M. T. Davisson on 2505. Paul I. Rongved, G. S. Kovacs, and R. T. Frankian on 2575. Paul Baumann, Maurice L. Dickinson on 2578. Donald S. Mansell on 2615. H. G. Hopkins on 2627.

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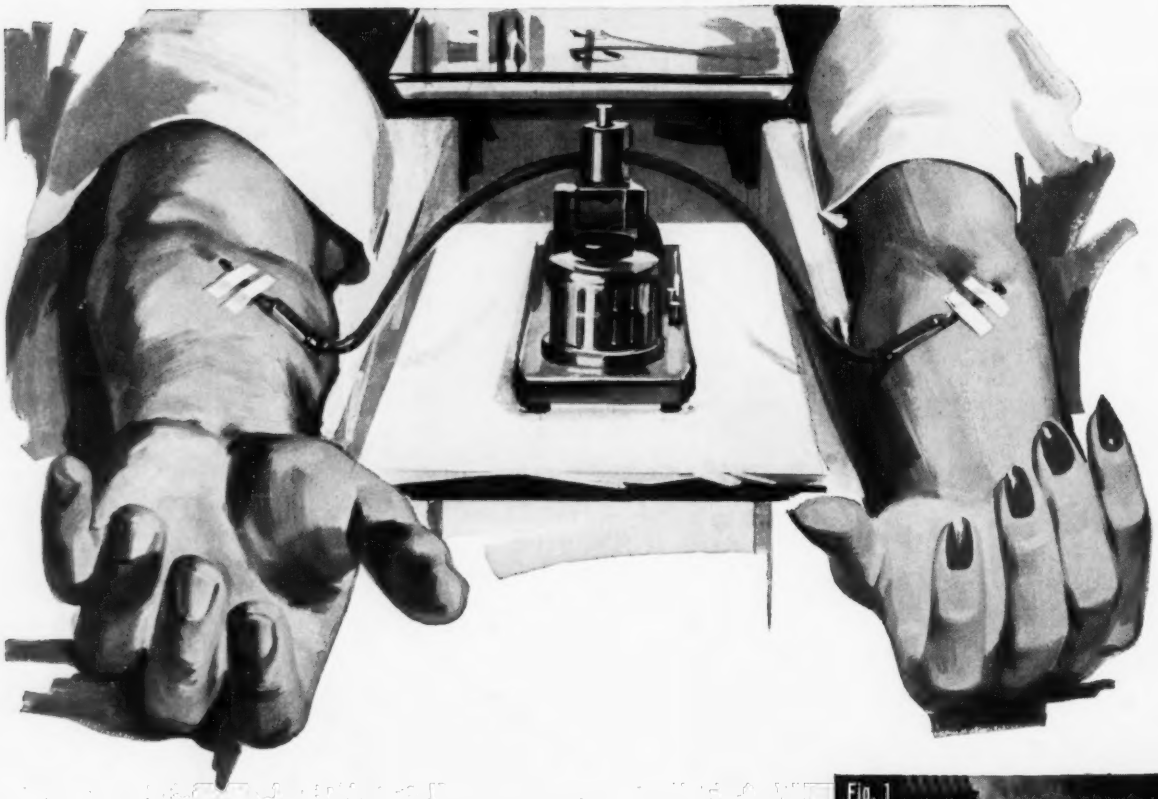

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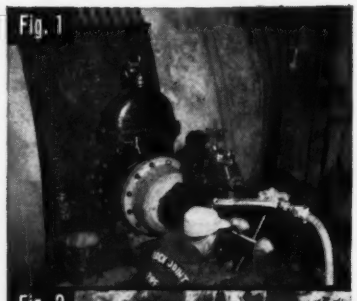
Fig. 1

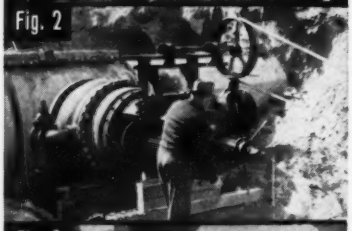
Fig. 2

Fig. 3

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